TAP JUGGLING

Test Anything Protocol - everywhere

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Public

INTRODUCTION

INTRODUCTION | *Abstract*

The Operating System Research Center (OSRC), a global AMD Research organisation headquartered in Dresden, Germany, acts as a bridge between the OS development community and the worldwide AMD processor design community.

At the OSRC we develop and run a test infrastructure called "Tapper". One of its used essential technologies is the Test Anything Protocol, or TAP.

By that postulate we use, write, and combine TAP tools in occasionally unorthodox ways to achieve our goals. In this talk I will give an overview of available TAP tools and related topics.

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INTRODUCTION | *Context*

- Operating System Research Center (OSRC)
- We developed and run a test infrastructure called *Tapper*
  - Automated testing of operating systems and virtualization (Xen/KVM)
  - Published as open source in 2011
    - http://github.com/amd
    - http://developer.amd.com/zones/opensource/AMDTapper
- Central idea: Test Anything Protocol - TAP
  - *Tapper* is a **TAP database**
  - We **"lazy evaluate"** TAP (in contrast to produce TAP)
  - TAP is our **daily business**
- Overview of available TAP tools
  - not restricted to *Tapper*

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INTRODUCTION | Motivation

- TAP is a data format
- Primarily for expressing test results
- Easier than XML, YAML, JSON, etc.
- Yet allows embedded YAML (simple subset)
- Errors are forgiven (non-TAP lines are ignored)
- Migrates all the complexity to the toolchain developer
- User "whipuptitute" + developer "manipulexity" ➜ low usage barrier

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INTRODUCTION | *Agenda*

- Escalate in complexity
  - Tier 1: TAP basics
  - Tier 2: TAP v13 and formatting
  - Tier 3: Transport meta information
  - Tier 4: TAP as document object model
  - Tier 5: Write TAP applications
  - Tier 6: Test waivers
  - Final Tier: Nested TAP

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TIER 1 | Trainee

TIER 1 | TAP Basics

- Line-based protocol
- Starts with a "plan" – how many test lines expected
- Some "ok" test lines
- Some "not ok" test lines
- Directives # TODO / # SKIP on test lines
- Comment lines starting with "#"
- Unrecognized lines are ignored

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok
ok
not ok
```

- Plan and ok/not ok lines

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok - established connection
ok - checksum
not ok - transfer completed
```

- Plan and ok/not ok lines
- Test line descriptions

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok - established connection
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not ok - transfer completed
# got error message "Bummer!"
```

- Plan and ok/not ok lines
- Test line descriptions
- Comment lines

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok - established connection
ok - checksum
not ok - transfer completed # TODO we know it fails
# got error message "Bummer!"
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- Plan and ok/not ok lines
- Test line descriptions
- Comment lines
- Directives # TODO

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok - established connection
ok - checksum # SKIP no md5sum available
not ok - transfer completed # TODO we know it fails
# got error message "Bummer!"
```

- Plan and ok/not ok lines
- Test line descriptions
- Comment lines
- Directives # TODO / # SKIP

TIER 1 | TAP Basics | Synopsis

```
1..3
ok - established connection
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# got error message "Bummer!"
Hello? I am a statement lost in code, help me out!
```

- Plan and ok/not ok lines
- Test line descriptions
- Comment lines
- Directives # TODO / # SKIP
- Unrecognized lines are ignored

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TIER 1 | TAP Basics | Synopsis

```
1..3
ok 1 - established connection
ok 2 - checksum # SKIP no md5sum available
not ok 3 - transfer completed # TODO we know it fails
# got error message "Bummer!"
Hello? I am a statement lost in code, help me out!
```

- Plan and ok/not ok lines – optionally numbered
- Test line descriptions
- Comment lines
- Directives # TODO / # SKIP
- Unrecognized lines are ignored

TIER 1 | TAP Basics | Synopsis

```
1..3
ok 1 - established connection
ok 2 - checksum # SKIP no md5sum available
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```

- → TAP is like Perl

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ok 1 - established connection
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Hello? I am a statement lost in code, help me out!
```

- → TAP is like Perl (without sigils)

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TIER 1 | Run and evaluate TAP emitters

```
$ prove        foo.t                        # run + evaluate
$ prove -m     foo.t                        # run + evaluate + merge STDIN/OUT
$ prove -e cat static_tap_results.tap   # just evaluate
```

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TIER 2 | Skilled

TIER 2 | TAP v13

```
1..3

ok - established connection

ok - checksum # SKIP no md5sum available

not ok - transfer completed # TODO we know it fails

# got error message "Bummer!"

Hello? I am a statement lost in code, help me out!
```

```
1..4

ok - established connection

ok - checksum # SKIP no md5sum available

not ok - transfer completed # TODO we know it fails

# got error message "Bummer!"

Hello? I am a statement lost in code, help me out!

ok - transfer benchmarks
```

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```
1..4
ok - established connection
ok - checksum # SKIP no md5sum available
not ok - transfer completed # TODO we know it fails
# got error message "Bummer!"
Hello? I am a statement lost in code, help me out!
ok - transfer benchmarks
  ---
  benchmarks:
    pass1:
      snd: 1234.56
      rcv: 999.99
    pass2:
      snd: 1123.56
      rcv: 888.88
  ...
```

TIER 2 | TAP v13 | Embedded YAML

```
TAP Version 13
1..4
ok - established connection
ok - checksum # SKIP no md5sum available
not ok - transfer completed # TODO we know it fails
# got error message "Bummer!"
Hello? I am a statement lost in code, help me out!
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  ---
  benchmarks:
    pass1:
      snd: 1234.56
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    pass2:
      snd: 1123.56
      rcv: 888.88
  ...
```

TIER 2 | TAP v13 | Enforce version

- "`TAP Version 13`" - annoying detail for TAP producing end users
- Configure on consumer side

```
$ prove --tapversion=13
```

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TIER 2 | TAP Formatting

- HTML formatter

```
$ prove -Q --formatter=TAP::Formatter::HTML > out.html
```

- Same via plugin

```
$ prove -Q -P HTML:outfile:out.html
```

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TIER 2 | TAP Formatting

- HTML formatter

```
$ prove -Q --formatter=TAP::Formatter::HTML > out.html
```

- Same via plugin

```
$ prove -Q -P HTML:outfile:out.html
```

- Used in *Tapper*…

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TIER 2 | TAP Formatting

TIER 3 | Combat

TIER 3 | Transport meta information

- "Hot comments" - meta information in comment lines
- *Tapper*-specific extension to evaluate them
- Example: "t/00-tapper-meta.t"

```
use Tapper::Test;

tapper_suite_meta;
```

- Result TAP

```
1..1

ok 1 - tapper-suite-meta

# Tapper-suite-name:          Some-Library

# Tapper-suite-version:       3.000010

# Tapper-machine-name:        bascha

# Tapper-uname:               Linux bascha 2.6.35-30-generic #54-Ubuntu SMP x86_64 GNU/Linux

# Tapper-osname:              Ubuntu 10.10

# Tapper-cpuinfo:             2 cores [AMD Athlon(tm) 64 X2 Dual Core Processor 6000+]

# Tapper-ram:                 2007MB
```

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TIER 4 | Warrior

TIER 4 | TAP as document object model

- **TAP::DOM** – Synopsis

```perl
use TAP::DOM;

$tapdata = TAP::DOM->new( tap => $tapstr ); # same options as TAP::Parser

print Dumper($tapdata);
```

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- Resulting data structure

```
bless ({
  'tests_planned' => 6
  'tests_run'     => 8,
  # […]
  'summary' => {
      'status'         => 'FAIL',
      'total'          => 8,
      'passed'         => 6,
      'failed'         => 2,
      'skipped'        => 1,
      'todo'           => 4,
      'todo_passed'    => 2,
      # […]
  },
  'lines' => [
     { 'number'        => '1',
       'is_ok'         => 1,
       'description'   => '- use Data::DPath;',
       '_children'     => [ # subsequent comments/yaml
            { 'is_yaml' => 1,
              'data' => [ {'name'  => 'Hash one',
                           'value' => '1' },
                          {'name'  => 'Hash two',
                           'value' => '2' } ] } ] } ]
    # […  lines …]
  ] }, 'TAP::DOM')
```

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TIER 4 | TAP as document object model

- Uh, oh, complexity!
- `Data::DPath` to the rescue
  - **fuzzy** paths through data structures

    - `$tapdom ~~ dpath '//summary/passed'`
    - `$tapdom ~~ dpath '//description//foo'`

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TIER 4 | TAP::DOM and Data::DPath

- Example: find succeeding TODO tests

```
$ tap-emitting-test.sh | dpath -i tap '//has_todo[value==1]/../is_actual_ok[value==1]/..'


    ---
    - as_string:    "ok 149 - ANYWHERE + NOSTEP # TODO deferred"
      description:  "- ANYWHERE + NOSTEP"
      directive:    TODO
      explanation:  deferred
      has_todo:     1
      is_actual_ok: 1
      is_ok:        1
      is_test:      1
      number:       149
      type:         test
```

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TIER 4 | TAP::DOM and Data::DPath

- Example: extract benchmarks

```
$ perl xt/large_data.t | dpath -i tap //wallclock
```

TIER 4 | TAP::DOM and Data::DPath

- *Tapper* use case: "TAP pass-through"

  - Subscribe to dedicated data blocks in TAP and forward them
  - Test suite → *Tapper* "reports receiver" → "level 2 receivers"
  - Subscribe to subsets of test results
  - Extract and forward to appropriate 3rd party applications
  - E.g., benchmark values to codespeed application

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TIER 4 | TAP::DOM and Data::DPath

- *Tapper* use case: "TAP pass-through"

```
# anywhere inside big TAP report...
ok - benchmark example data
  ---
  codespeed:
    -
      benchmark: example1
      commitid: 1b1a3d2a
      environment: myhost
      executable: perl-5.12.1
      project: perl
      result_value: 12.345
    -
      benchmark: example2
      commitid: 1b1a3d2a
      environment: myhost
      executable: perl-5.12.1
      project: perl
      result_value: 9.876
  ...
# some more TAP
```

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TIER 4 | TAP::DOM and Data::DPath

- *Tapper* use case: "TAP pass-through"

  – TAP pass-through implemented in 2 lines

```
method forward_to_codespeed ($tap_dom) {
        # step 1 - fuzzy subscription path
        $chunks = $tap_dom ~~ dpath("//data/codespeed");
        # step 2 - pass-through
        $lwp_useragent->post("http://CODESPEED/result/add/", $_) foreach @$chunks;
}
```
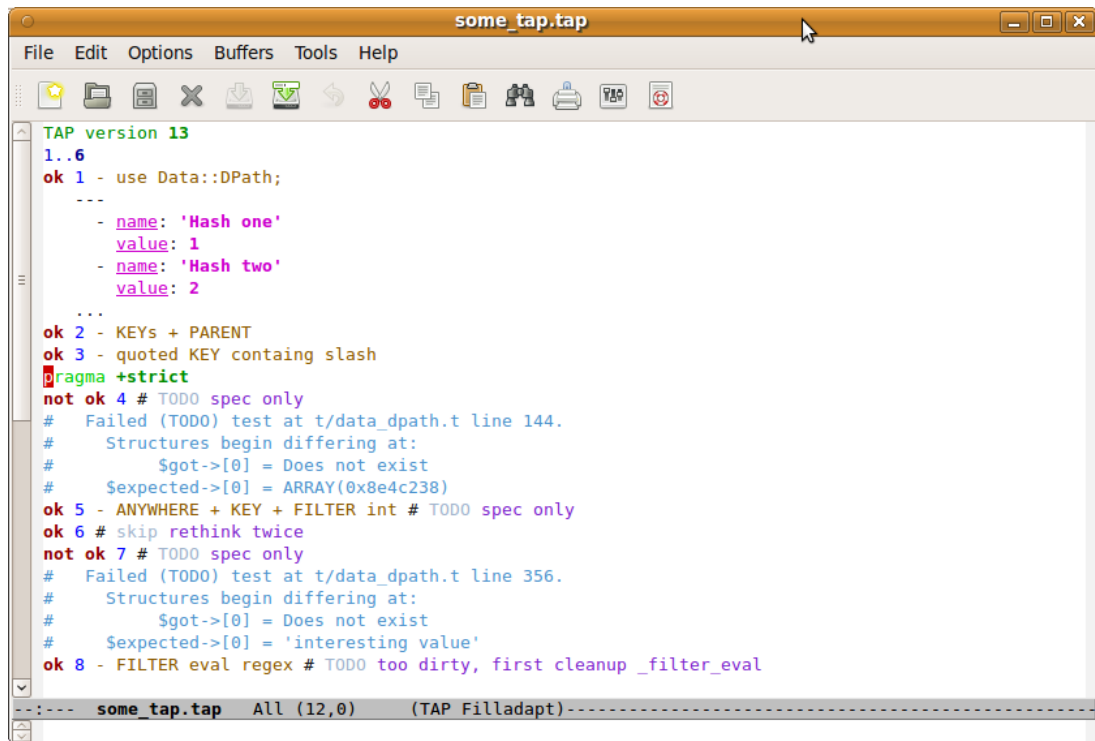
TIER 5 | Veteran

TIER 5 | Writing TAP applications

- Emacs mode
- `prove` plugins
- TAP transformers

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TIER 5 | Emacs tap-mode

- Use Emacs `tap-mode` to edit TAP

TIER 5 | Writing *prove* plugins

- Carve out TAP from `prove`

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TIER 5 | Writing `prove` plugins

- Carve out TAP from **`prove`**

  - "**`prove -v`**" reprints TAP

  - Idea: branch off TAP immediately during test run, but…

```
$ prove -vl t/foo.t
t/foo.t ..
1..1
ok 1 - use FOO
ok
All tests successful.
Files=1, Tests=1,  0 wallclock secs ( 0.10 usr  0.00 sys +  0.26 cusr  0.03 csys =  0.39 CPU)
Result: PASS
```

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TIER 5 | Writing *prove* plugins

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ok                              <-- extra "ok" line - Bummer!
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  - **prove** output is not "idempotent"

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  - **prove** output is not "idempotent"

  - Since **TAP::Harness** v3.24 the ok line can be overwritten

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TIER 5 | Writing `prove` plugins

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  - "**prove -v**" reprints TAP
  - Idea: branch off TAP immediately during test run, but…

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All tests successful.
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Result: PASS
```

  - **prove** output is not "idempotent"
  - Since **TAP::Harness** v3.24 the ok line can be overwritten
  - Module **App::Prove::Plugin::Idempotent** to the rescue

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TIER 5 | Writing `prove` plugins

- Carve out TAP from **prove**

  - "**prove -v**" reprints TAP

  - Idea: branch off TAP immediately during test run, but…

    ```
    $ prove -vl -P Idempotent  t/foo.t
    t/foo.t ..
    1..1
    ok 1 - use FOO
    All tests successful.
    Files=1, Tests=1,  0 wallclock secs ( 0.10 usr  0.00 sys +  0.26 cusr  0.03 csys =  0.39 CPU)
    Result: PASS
    ```

  - **prove** output is not "idempotent"

  - Since **TAP::Harness** v3.24 the ok line can be overwritten

  - Module **App::Prove::Plugin::Idempotent** to the rescue

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TIER 5 | TAP transformers

- De-concatenate multiple TAP blocks from `prove`

TIER 5 | TAP transformers

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  - Problem: "`prove -v`" reprints TAP from many files concatenated

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TIER 5 | TAP transformers

- De-concatenate multiple TAP blocks from **`prove`**
    - Problem: "**`prove -v`**" reprints TAP from many files concatenated

```
$ prove -vl -P Idempotent t/foo.t t/bar.t
t/foo.t ..
1..1
ok 1 - use FOO
t/bar.t ..
1..1
ok 1 - use BAR
All tests successful.
Files=1, Tests=1,  0 wallclock secs ( 0.10 usr  0.00 sys +  0.26 cusr  0.03 csys =  0.39 CPU)
Result: PASS
```

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TIER 5 | TAP transformers

- De-concatenate multiple TAP blocks from **prove**

  – Solution: Module **TAP::Splitter** recognizes TAP borders

    - TAP version line

    - Plan line (1..3)

    - prove's filename line

```
use TAP::Snipper;
$tap     = slurp ("$temp/too_much_tap_in_one_go.tap");
$snipper = TAP::Snipper->new( tap => $tap );
$snipper->_parse_tap_into_sections;
# ARRAY of TAP blocks:
#   $snipper->parsed_report->{tap_sections}[*]{raw}
```

TIER 6 | Master

TIER 6 | Test waivers

- "Test waiver" == "ignore known issue for a reason"

- The test has already been run, the result **is** there, we just don't like it

- We need "lazy evaluated" exceptions to test results

- That's in contrast to marking tests "`# TODO`" in advance

- Example:
  - Software project might not run with IPv6
  - But you want to see a big SUCCESS or NO SUCCESS in an IPv4-only context
  - Statically marking tests with "`# TODO`" requires changing back and forth
  - Dynamically marking tests depending on environment conflicts
    with debugging the problem
  - Solution:
    - append "`# TODO explanation`" to dedicated NOT OK lines, **after** you run the tests
  - How to patch?
    - Change the `TAP::DOM`, regenerate raw TAP

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TIER 6 | Test waivers

- **TAP::DOM::Waivers** -- match **DPath**, apply **TAP::DOM** hash merge

```perl
use TAP::DOM;
use TAP::DOM::Waivers 'waiver';
$dom = TAP::DOM->new( tap => "somefile.tap" );
$waivers = [
     {
       # a description of what the waiver is trying to achieve
       comment     => "Force all IPv6 stuff to true",

       # a DPath that matches the records to patch:
       match_dpath => [ "//lines//description[value =~ 'IPv6']/.." ],

       # apply changes to the matched records,
       # here a TODO with an explanation:
       patch       => {
                        is_ok       => 1,
                        has_todo    => 1,
                        is_actual_ok => 0,
                        explanation  => 'waiver for context xyz',
                        directive    => 'TODO',
                      },
     },
];
$patched_dom = waiver($dom, $waivers);
print NEWFILE $patched_dom->to_tap;
```

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TIER 6 | Test waivers

- **`TAP::DOM::Waivers`** -- meta patches, common cases like "**`TODO`**" or "**`SKIP`**"

```
$waivers = [
    {
      comment          => "Force all IPv6 stuff to true",
      match_dpath      => [ "//lines//description[value =~ 'IPv6']/.." ],
      metapatch        => { TODO => 'waiver for context xyz' },
    },
];
```

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TIER 6 | *Test waivers*

- **`TAP::DOM::Waivers`** -- meta patches, very often you match by description

```
$waivers = [
    {
        comment          => "Force all IPv6 stuff to true",
        match_description => [ "IPv6" ],
        metapatch         => { TODO => 'waiver for context xyz' },
    },
];
```

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FINAL TIER

FINAL TIER | Nested TAP

- Nested TAP

```
TAP Version 13
1..2
ok 1 - established connection
  1..3
  ok 1 - step 2-1
  ok 2 - step 2-2
  ok 3 - step 2-3
ok 2 - transfer completed (summary of nested 2-x lines --> backwards compatible)
```

- Rerun Tier 1 to 6 with nested TAP
- Left as an exercise for the audience

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FINAL TIER | Nested TAP

- Nested TAP

```
TAP Version 13
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- The End.

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