Storing and Outputting Test Information: KUnit Attributes and KTAPv2

Rae Moar <rmoar@google.com>

Outline

- Background on KUnit and Supplemental Test Information
- KUnit Test Attributes
- How to Output Test Information in KTAP
- KTAP v2
- Questions

What Is KUnit?

What Is KUnit?

- A Unit Testing framework for the Linux Kernel.
- Upstream since 5.5
- Tests are written in C and run in kernel mode
- Tools to run these tests, and parse the results:
  - ./tools/testing/kunit/kunit.py run
  - Uses User-Mode Linux by default, or QEMU for other architectures.
  - ./tools/testing/kunit/kunit.py run --arch x86_64

Background on Test Information

Background on Test Information

- What do we mean by Test Information?
  - Not talking about the value of variable "x" used during test execution
  - Information primarily for user interaction either before or after test execution (like test name or speed of test)
- Current Norm of Test Information
  - Basics (test name, result) very well categorized
  - Everything else is pretty unorganized
- Is this a good system?
- Could we instead take that supplemental test information and make it more useful?

```
KTAP version 1
1..1
    KTAP version 1
    1..2
    ok 1 test_1
    # test_2: this test is flaky and super slow
    not ok 2 test_2
not ok 1 test_suite
```

Background on Test Information

- There is a wide variety in test information
- Examples:
  - **speed:** The relative speed of a test (enum categories: normal, slow, very slow)
    - Inspiration: CONFIG_MEMCPY_SLOW_KUNIT_TEST
    - How is it useful?
      - Filter out tests based on speed
    - Needs: Manually Stored, Filtering, Outputted in KTAP
  - **is_init:** Whether the test uses init data or functions (bool)
    - How is it useful?
      - Filter out init tests if the init section could be discarded
    - Needs: Auto Generated and Stored, Filtering

Background on Test Information

- One More Example:
  - **output_files:** list of file path of auxiliary files that could be generated during test execution (list of strings)
    - How is it useful?
      - Read during output to give extra context to test results
    - Needs: Stored during Test Execution, Outputted in KTAP
- What do we need to implement a framework for this test information?
  - Store information manually and auto-generated (a variety of data types)
  - Filter based on test information
  - Output this in a readable and parsable way (in KTAP)

KUnit Attributes

KUnit Attributes

- **Objective:** To save and access supplemental test information
- **Current Attributes:** speed, module name
- What can you do with KUnit Attributes?
  - Create attribute of any data type
  - Mark tests (manually or auto-generated)
  - Filter Tests
  - Output to KTAP
- **How to Use:**
  - Add attributes using the struct kunit_attributes
    - or KUNIT_CASE_SLOW()
  - To filter use module param kunit.filter or kunit.filter_skip
    - Tooling Flags: --filter or --filter_skip

```
static const struct kunit_attributes example_attr = {
      .speed = KUNIT_SLOW,
      .is_flaky = true,
};
```

```
static struct kunit_case example_test_cases[] = {
      KUNIT_CASE_ATTR(example_test, example_attr),
};
```

KUnit Attributes Example

Running KUnit with Default Settings:

```
Testing complete. Ran 312 tests: passed: 304, skipped: 8
Elapsed time: 10.352s total, 0.001s configuring, 3.105s building, 7.212s running
```

Running KUnit with Default Settings Plus Filter out 6 Slow Tests:

(Command: ./…/kunit.py run --filter "speed>slow")

```
Testing complete. Ran 306 tests: passed: 298, skipped: 8
Elapsed time: 3.964s total, 0.001s configuring, 3.143s building, 0.814s running
```

Major Difference in Time!

- Elapsed Time: **63%** faster
- Running Time: **89%** faster

Potential KUnit Attributes

- **is_init**
  - Whether the test uses init data or functions (bool)
  - To prevent re-running init tests after boot
- **file**
  - File path of suite (i.e. lib/kunit_example.c)
  - Useful when looking up test that is failing
- **custom_tags**
  - A list of strings ("tags") to mark the test that can be personalized to the test suite
- **Parameterized test attributes**
  - Implement a generate_attrs function to assign attributes given a parameter

```
static struct kunit_attributes example_gen_attrs(const void *test_param)
{
	struct kunit_attributes attrs = {};
	const int *val = test_param;

	if (*val == 2)
		attrs.speed = KUNIT_SPEED_SLOW;
	return attrs;
}
```

KTAP Output

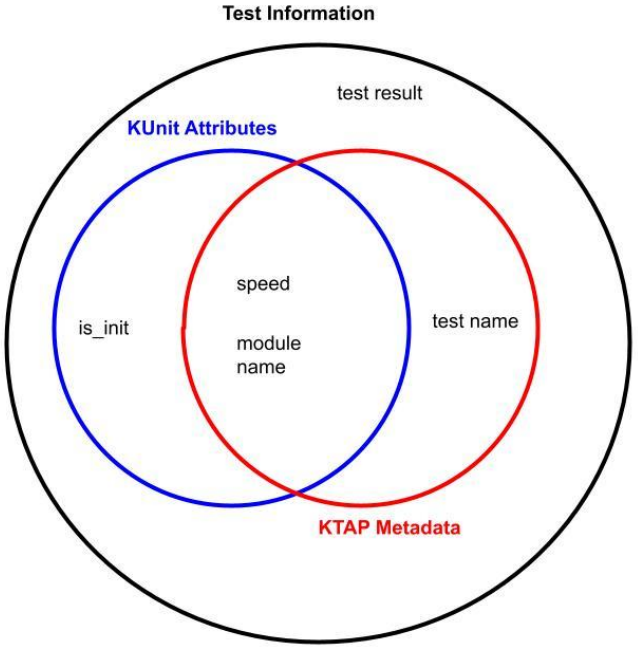
KTAP Output

- How should KUnit Attributes and other test information be formatted in KTAP?
  - Identifiable
  - Parsable
  - May need to add to KTAP v2 to create a specification
- KTAP Metadata Proposal (link)
  - Metadata lines format
    - "# type: value"
    - Diagnostic line to aid existing parsers
    - Header is "# test: name"
  - Location
    - **Suites:** Located between KTAP version line and test plan line (1..x)
    - **Test Cases:** Located prior to test result line

```
KTAP version 2
1..1
    KTAP version 2
    # test: test_suite
    # module: example
    1..2
    ok 1 test_1
     # test: test_2
    # speed: slow
     # test_2: initializing  // diagnostic line
    ok 2 test_2
ok 1 test_suite
```

KTAP Metadata

- Metadata types currently discussed:
  - Test names
  - File path and Module name
  - Speed
  - Config info
  - Supplemental files paths
  - What others should we consider? Does not need to be KUnit Attribute
- Custom metadata types:
  - Would not need to be in spec before using
  - Could use prefixes:
    - ktap_[type]: indicates KTAP specified
    - custom_[type]: indicated not KTAP specified



KTAP v2

- Proposals have been submitted for KTAP v2
  - KTAP Metadata
  - "skip" test result
- All changes on a separate branch within Frank's Tree
  - https://elinux.org/Test_Results_Format_Notes#KTAP_version_2
- Open Questions:
  - How should we continue to develop KTAP v2?
  - What is the ideal timeline for KTAP v2?

Open Questions

Open Questions

- What KUnit attributes should we be saving?
- Would generating KUnit attributes be helpful for parameterized tests? Are there specific attributes to add for parameterized tests?
- What are thoughts on the proposed format of KTAP Metadata? What test information should be saved as a specified type of KTAP Metadata?
- How can we support the development of KTAP v2?