Unified functional/load test architecture and methodology using TTCN-3

TELEFÓNICA I+D
Date: June 1st, 2007

Index

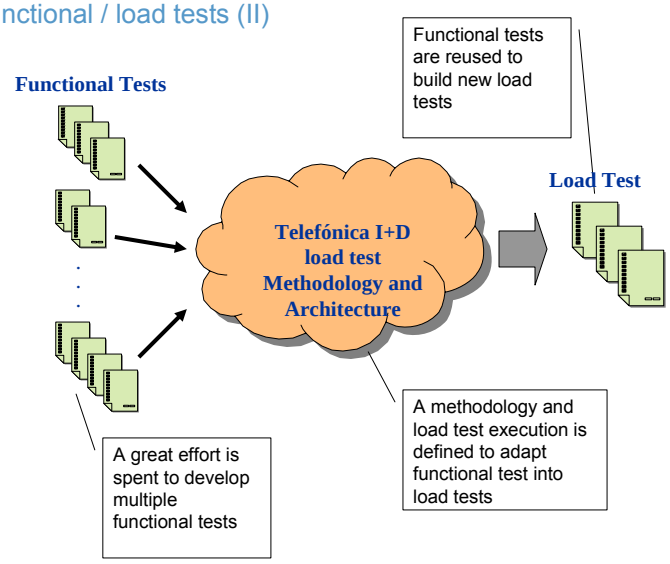
01 Current Telefónica I+D testing scenary

Functional / load tests (I)

- In Telefónica I+D certification processes, two main test phases can be distinguished:
  - Functional test:
    - Conformance
    - Checking system requirements
  - Load test:
    - Performance
    - Stress
    - Robustness

01 New Telefónica I+D testing solution

Functional / load tests (II)

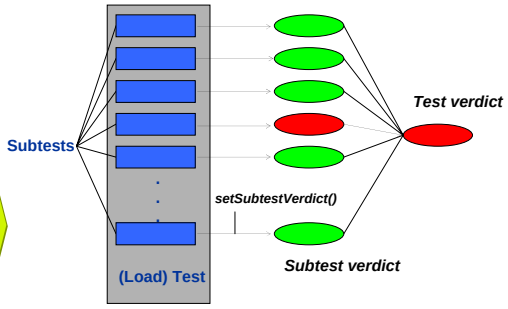


02 Telefónica I+D testing architecture

Tests and subtests (I)

TID architecture for load tests is based on the concept of subtest:

- A *subtest* is the minimum unit of test execution, to which a verdict can be assigned.
- A test (in particular, a load test) may be composed by several subtests.

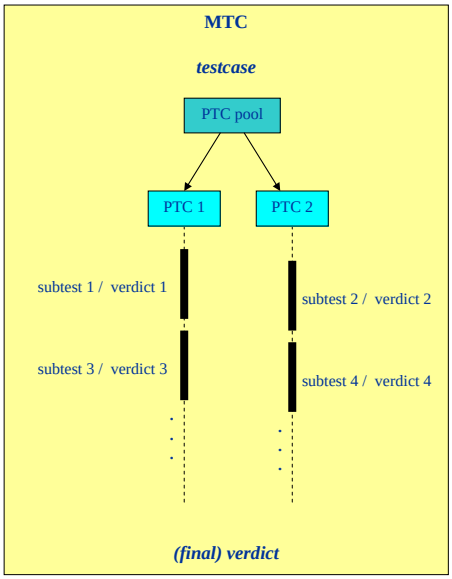


It is possible to build complex tests from existing simpler tests, retaining verdict information for them.

02 Telefónica I+D testing architecture

Tests and subtests (II)

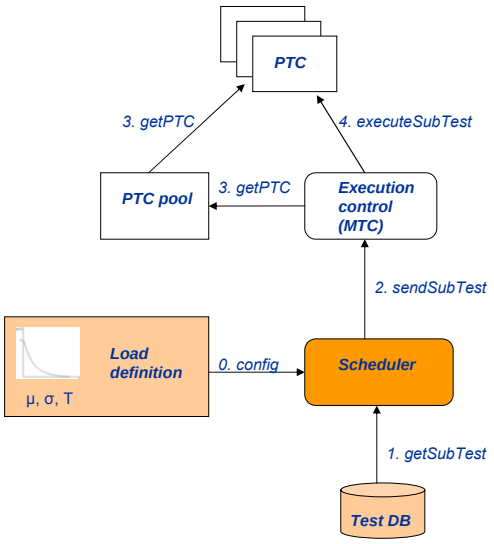
- A good performace for load testing needs the execution of several test behaviours on the same PTC, using a PTC pool.
- Current TTCN-3 specification do not allow running more than one testcase simultaneously and associates partial verdicts to components.
- Subtests keep verdicts related to their respective behaviours.



02 Telefónica I+D testing architecture

Load test execution (I)

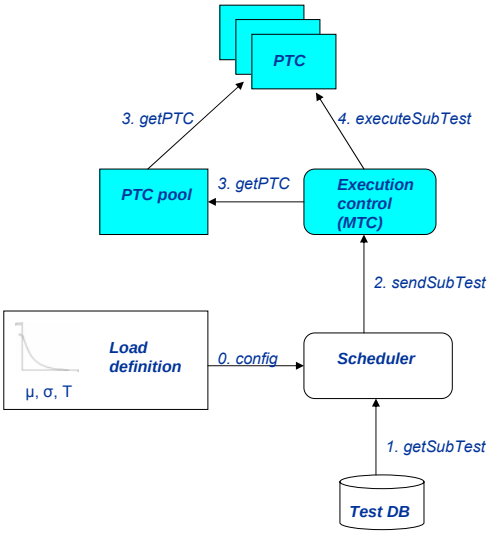
- *Scheduler:*
  - Defines the instants to execute subtests, from a statistic load distribution (*load definition*)
  - Controls test duration
  - Gets subtest parameters from database
  - In Telefónica I+D architecture Scheduler is part of the TM (*Test Manager*), but it could be included in ATS



02 Telefónica I+D testing architecture

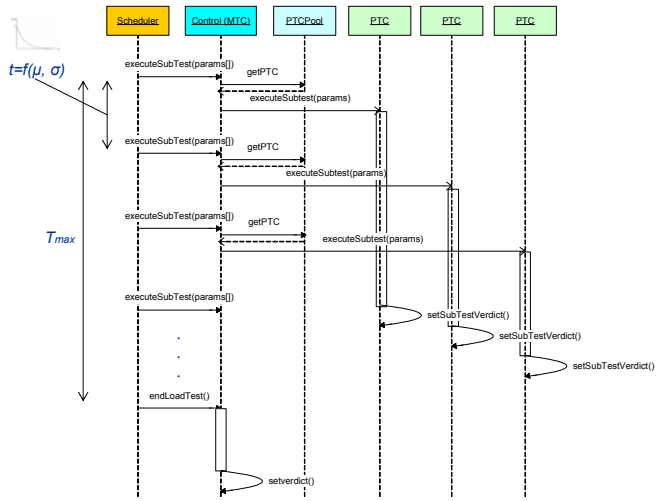
Load test execution (II)

- *Execution control (MTC):*
  - Executes subtests in PTCs and controls their state
  - Manages a PTC pool to optimize performance



02 Telefónica I+D testing architecture

Load test execution (III)



02 Telefónica I+D testing architecture

Load test configuration (I)

- A load test is configured by:
  - Test specification:
    - Using a test database:
      - It contains the parameters wich define the subtests, i.e. it says what is going to be tested.
      - It allows merging easily different types of subtests, so it is possible to model more realistic scenarios.
      - A database also can be used in functional tests as a way to define sets of related tests.
  - Load statistic modeling:
    - Subtest execution rate (mean, variance, etc).
    - Several probability density functions are possible, which can be easily configured.

02 Telefónica I+D testing architecture

Load tests configuration (II)

- Advantages:
  - Reuse of functional tests
  - Quick and simple load test configuration
  - More realistic tests
  - Increase in the number of scenarios which can be tested
  - Statistical modeling independent from test specification

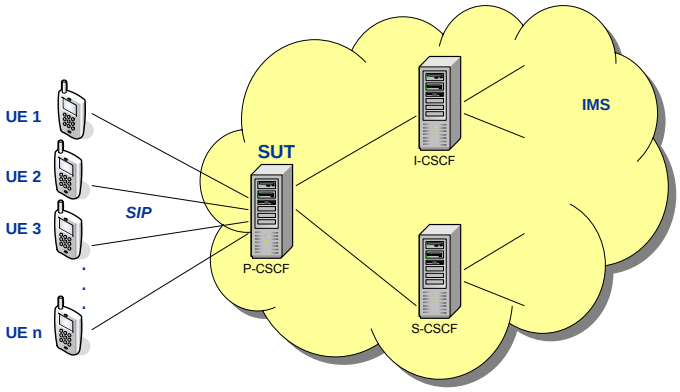
03 Telefónica I+D testing methodology

- A methodology for building load tests from functional tests is defined:
  - Specifies which conditions must be fulfilled by functional testcases and some transformation rules:
    - For example, testcases must be parameterized because several subtests will be executed concurrently with diferent parameters.
    - TTCN-3 behaviours could not use the order '*kill*' to prevent the premature finalization of the PTC.
    - The external function '*setSubtestVerdict*' must be used instead of '*setverdict*', to allow keeping verdict information for subtests.
    - Etc.
  - Defines *templates* to build TTCN-3 modules.
  - Includes common modules (TTCN-3 code and adaptation libraries) to support load tests:
    - PTCs pools
    - Interaction with parameters databases
    - Subtest verdicts management

03 Telefónica I+D testing methodology

SIP load test example (I)

- Load SIP test built from functional SIP tests



03 Telefónica I+D testing methodology

SIP load test example (II)

- Load SIP test built from functional SIP tests
  - From functional testcases:
    - Register
    - Subscription
    - SIP call stablishment
  - Steps:
    1. Make changes on original ATS:
       - Import load test support modules.
       - Modify component definitions (in wich subtests are going to be executed) to make them manageable by a PTC pool.
       - Substitute '*setverdict()*' by '*setSubtestVerdict()*' in subtests behaviours.
    2. Write load execution control module code and the main testcase.
    3. Configure load test: parameters database and density probability function.

03 Telefónica I+D testing methodology

SIP load test example (III)

```
/** Simplified SIP load testcase, using a PTC pool.
*   Load execution control code.
*/
testcase loadTest(charstring px_ets_ipaddr, integer px_ets_port, charstring px_iut_ipaddr, integer px_iut_port, charstring registrar_host) runs on
        SipComponent system SipInterfaces {
        trz(INFO, "Starting MTC for load tests");
        var integer subtest_counter := 0;
        // PTC pool initialization
        var Pool ptcPool := {self};
        while (not isLoadTestStoped()) {
                // Gets next subtest
                var LoadTestParams params := popSubtest();
                var SipComponent ptc;
                // Look for a free PTC from pool
                ptc := getPTCFromPool(ptcPool);
                // Executes testcase
                subtest_counter := subtest_counter + 1;
                trz(INFO, "Starting subtest " & int2str(subtest_counter));
                ptc.start(step_test_register_param(params[1].charstring, params[2].integer,  params[3].charstring, params[4].integer,
        params[5].charstring, params[6].integer));
        }
setverdict(pass);
}
```


03 Telefónica I+D testing methodology

SIP load test example (IV)

```
/*  Modified functional test (SIP register). */
function step_test_register_param (charstring px_ets_ipaddr, integer px_ets_port, charstring px_iut_ipaddr, integer px_iut_port,  charstring registrar_host, integer
        subtest_index) runs on SipComponent {
        // Initilialize
        map (self: SIPP, system: UDP1);
        ...
        // Send register
        ...
        // Timestamp for statistic generation
        timestampLoad("RegisterStart", subtestIndex);
        SIPP.send (REGISTER_Request_s_1(v_RequestUri, v_CallId, v_CSeq, v_Contact, v_From, v_To, v_Via));
        // Wait for response
        TAck.start (PX_TACK);
        alt {
                [] SIPP.receive (My_Response_REGISTER_200(v_CallId,  v_CSeq)) {
                                TAck.stop;
                                setSubtestVerdict(pass, subtestIndex);
                }
                [] TAck.timeout {  setSubtestVerdict(fail, subtestIndex); }
        }
        // Timestamp for statistic generation
        timestampLoad("RegisterEnd", subtestIndex);
        ...
        unmap (self: SIPP, system: UDP1);
}
```

03 Telefónica I+D testing methodology

SIP load test example (V)

- Test parameter database example

px_ets_ipaddr	px_ets_port	px_iut_ipaddr	px_iut_port	registrar_host	P_PTC_1_REQUEST_LINE_E	P_PTC_1_STATUS_LINE_R
10.95.25.64	5061	10.95.25.64	5060	10.95.25.104	-	*

10.95.25.65	5061	10.95.25.64	5060	10.95.25.104	{ method:=REGISTER_E,
					requestUri:={
					scheme:="sip",
					hostPort:={
					host:="ptt4.trial.net"
					}
					},
					sipVersion:="SIP/2.0" }
						{ sipVersion:="SIP/2.0",
						statusCode:=200,
						reasonPhrase:="OK"}

10.95.25.66	5061	10.95.25.64	5060	10.95.25.104	-	*
10.95.25.67	5061	10.95.25.64	5060	10.95.25.104	-	*
10.95.25.68	5061	10.95.25.64	5060	10.95.25.104	-	*
10.95.25.69	5061	10.95.25.64	5060	10.95.25.104	-	*

04 Possible improvements to TTCN-3 specifications

- To add the concepts of subtests and subtest verdicts
- Support for parameter databases:
  - It may be implemented within TM (Test Management system).
  - However, allowing database from ATSs could improve power and flexibility of ATSs.
- Improvements in PTC management:
  - PTC pools
- Improvements in log management:
  - Log filtering at TE (TTCN-3 Executable) for better performance
  - Several detail levels
- Support for statistic generation:
  - Timestamp mechanism correlated to subtests


Telefónica