# Test Generation towards TTCN-3

Paul Baker

# Background

- **Model-Driven Development (MDD)**
  - Motorola's is a maturity MDD company
  - Mature software company:
    - SEI CMM & CMMI levels range between 3-5
- **Standards Participation**
  - *ITU-T/ETSI:* MSC, SDL, TTCN-3 (GFT),
  - *OMG:* UML 2.0 & UML 2.0 testing profile
- **Requirements-based Test Generation & Verification**
  - MSC2000 and UML 2.0 test generation and verification

# Typical Test Process

- Test scripts manually prepared
- Time consuming
- Incomplete
- Informal
- Opportunity to introduce defects

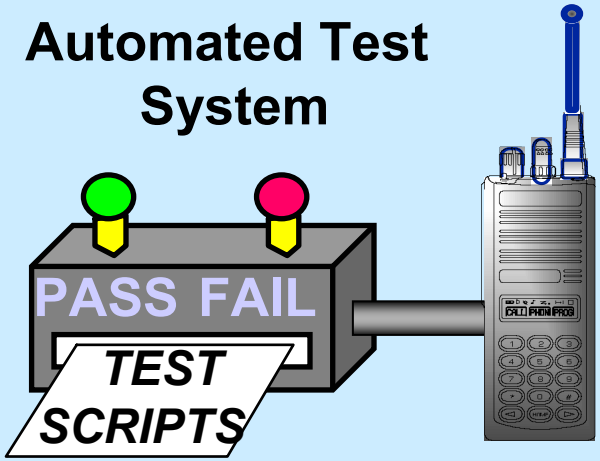
**Test Development**

**Test Scripts**

| Test 1 | Test 2 |
|---|---|
| Send y | Send x |
| ↓ | ↓ |
| Receive z | Receive w |
| ↓ | ↓ |
| Pass Test | Pass Test |

**Test Execution**

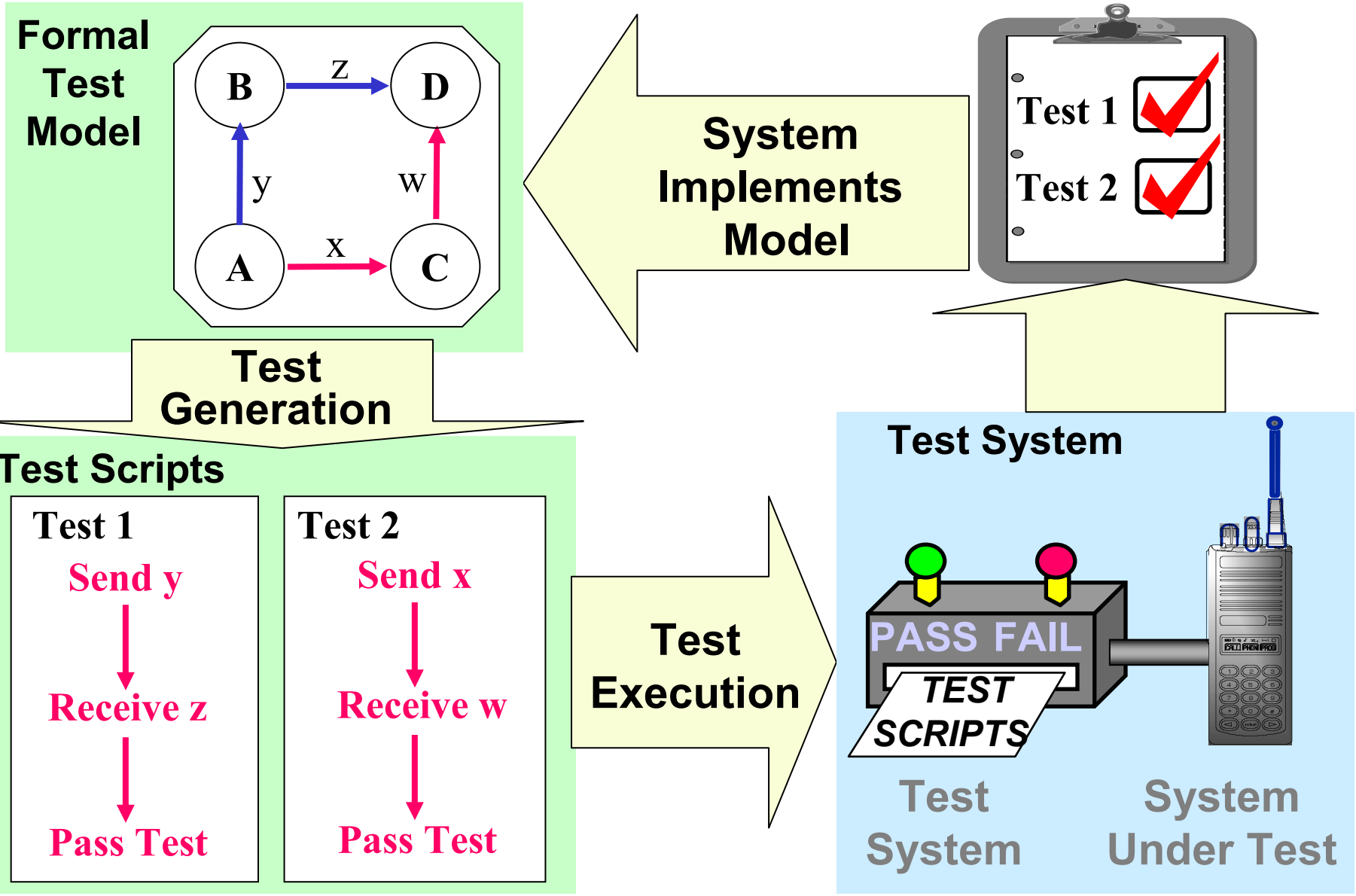
**Automated Test System**



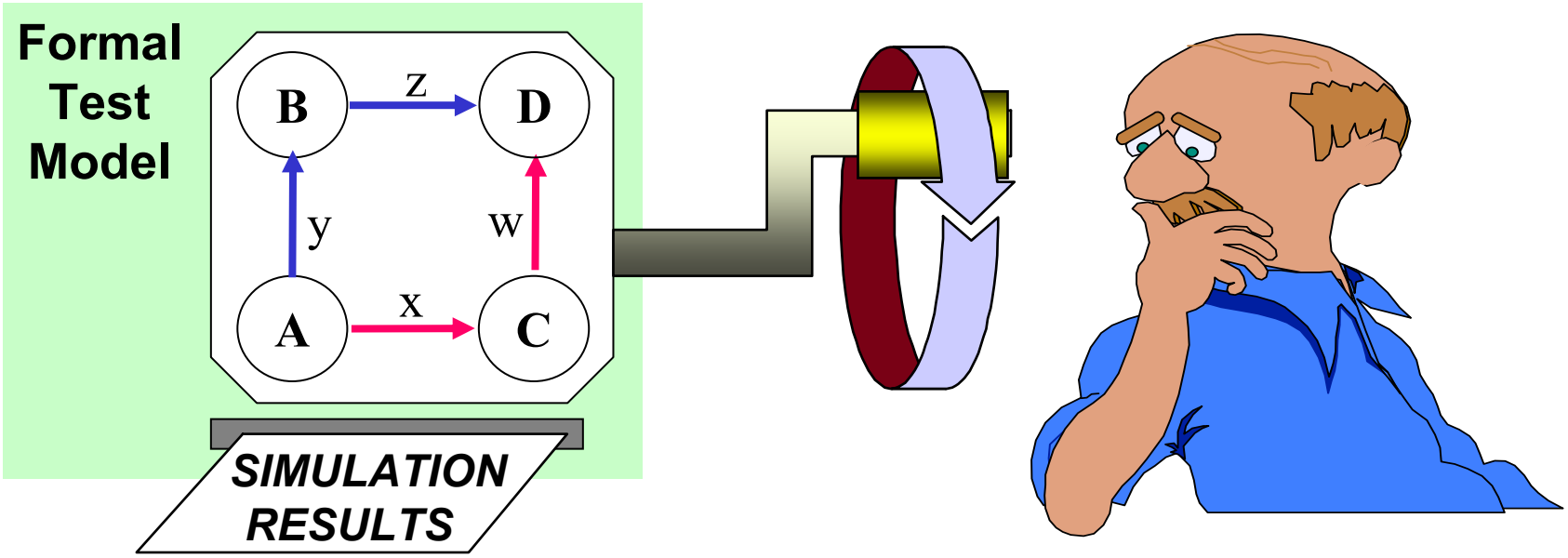

Test System

System Under Test

# Auto Test Generation Process



# Formal Test Models - Benefits




- Verification and validation – simulation
- Higher level of abstraction
- Test model maintained only
- Model may form part or all of the requirements

# Benefits of Auto Test Generation

## Reduced Cost of Producing Test Suites

- Hand-written tests normally lead to ‘representative’ tests.
- Greater *get off the ground* cost to set up test model
- Reported reduction factors of up to 3x


## Greater Test Coverage

- Exhaustive nature of auto-testing tools

## Improved Test Quality

- All possible scenarios are explored thereby generating unexpected or obscure tests

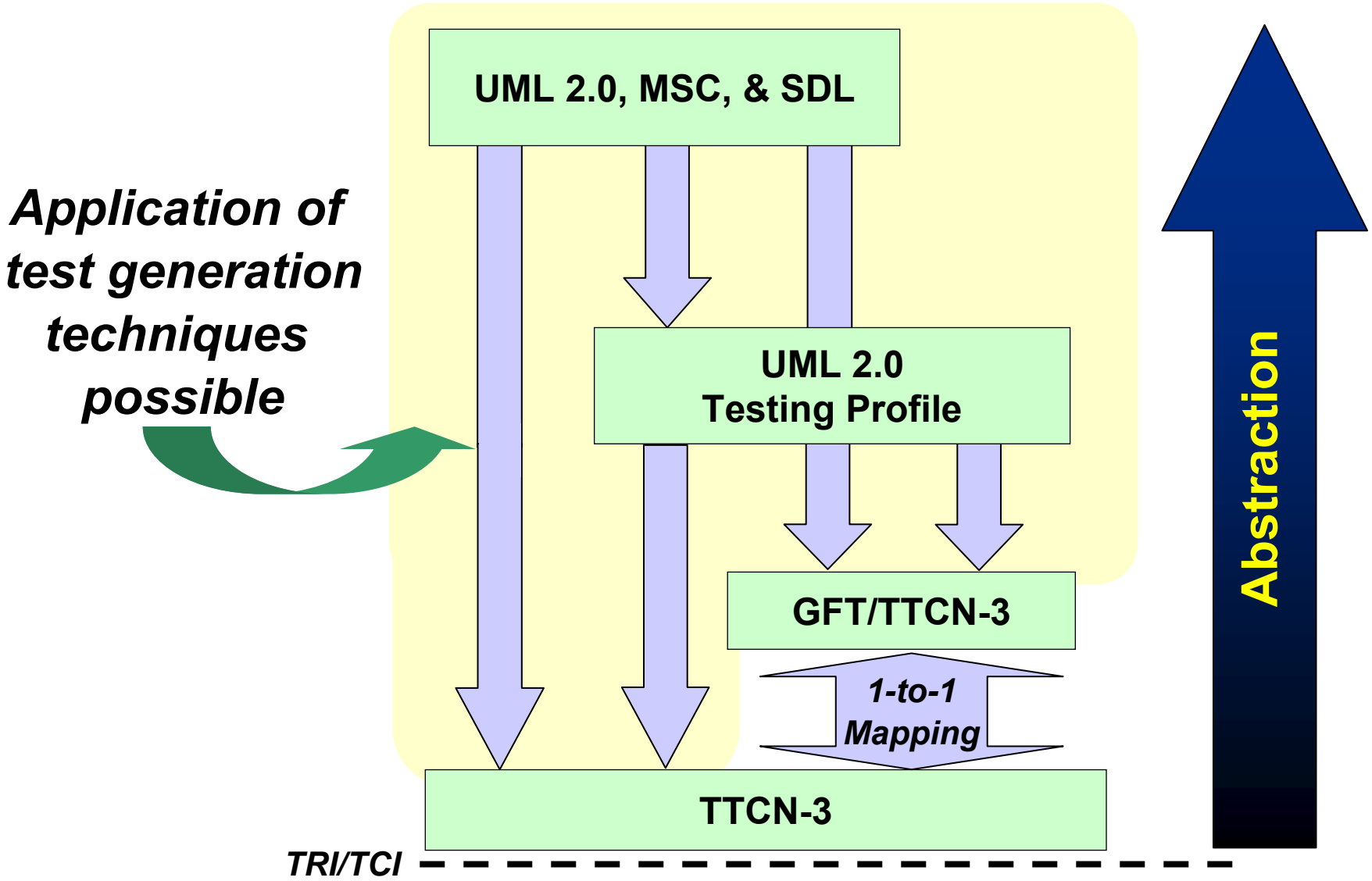
## Easier Test Suite Maintenance

- Only the test model needs to be maintained, rather than the test suite

# Some Test Generation Considerations

- **Abstraction**
- **Complexity**
  - Constraint mechanisms
  - Selection strategies
- **Test strategies/coverage**
- **Data**
  - Static and dynamic
  - Data Pools
- **Model/test correctness**
  - Valid tests
- **Test configuration**
- **Traceability**

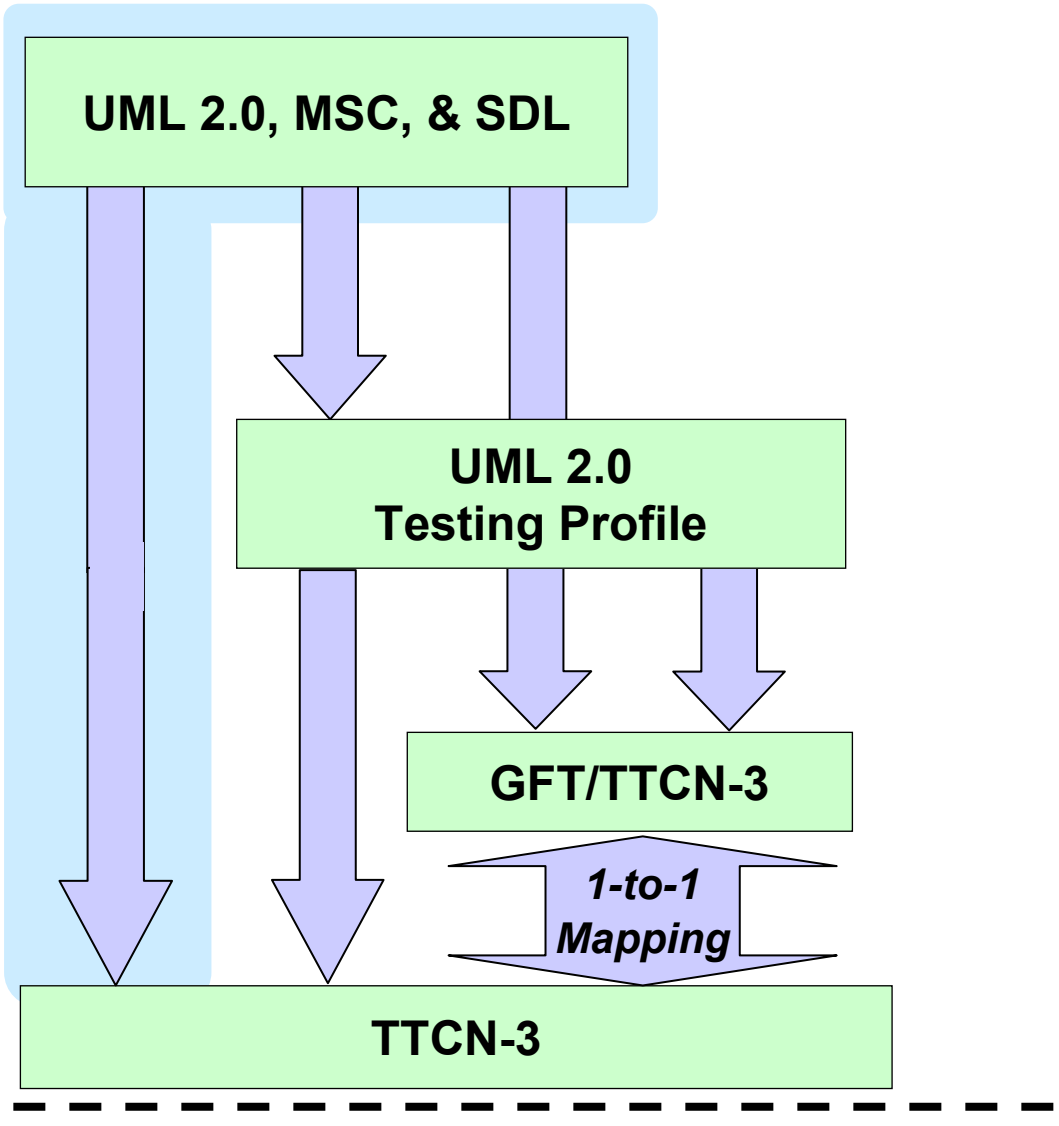
# TTCN-3 Landscape



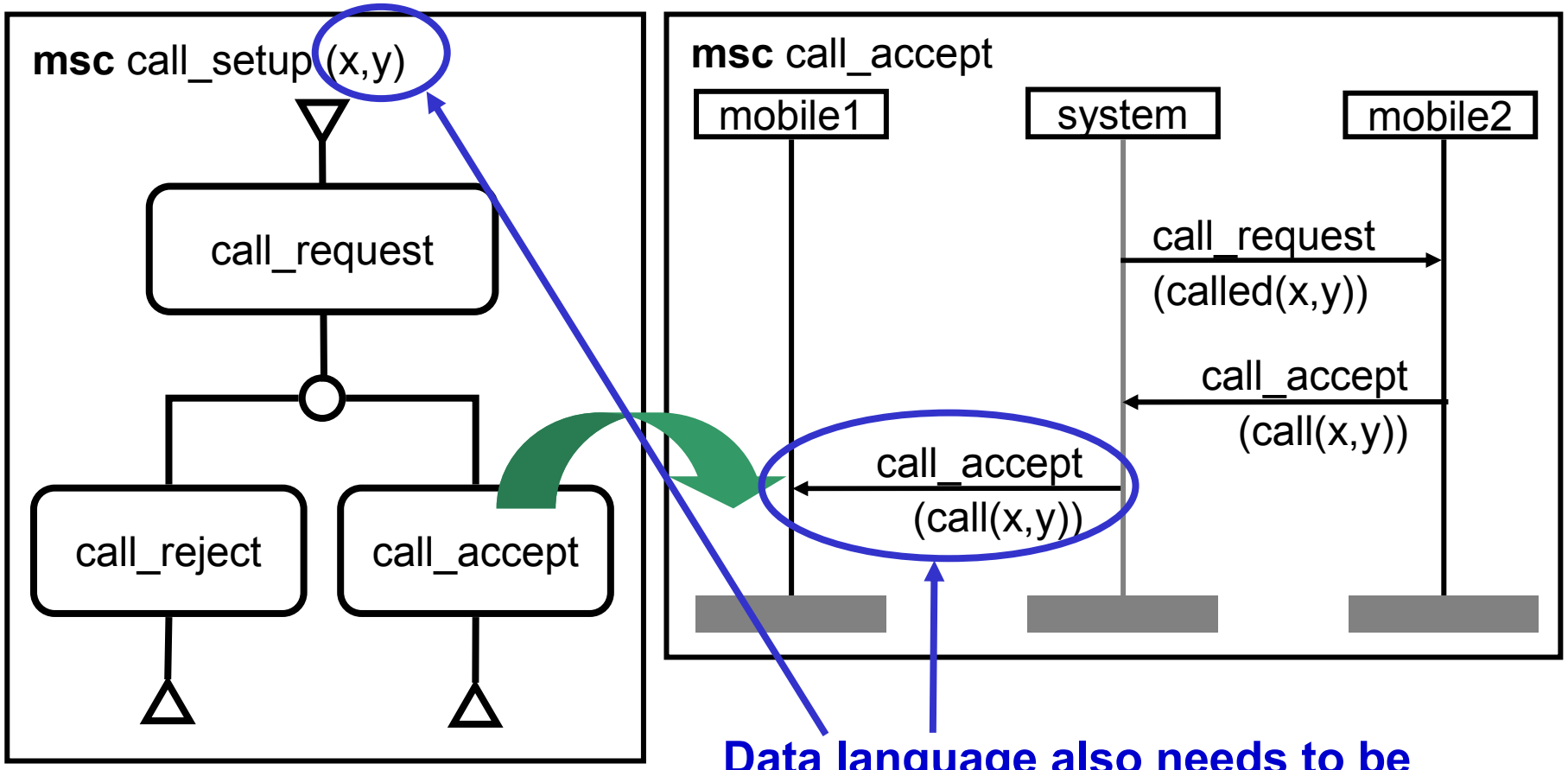
# Abstraction (1)

**The user does not need to be concerned with specifying:**
- test cases
- test configuration
- verdict handling
- exception handling
- test control

**At this level of abstraction the user is concerned with:**
- the behaviour definition of the system with its environment
- test coverage & strategies
- model correctness

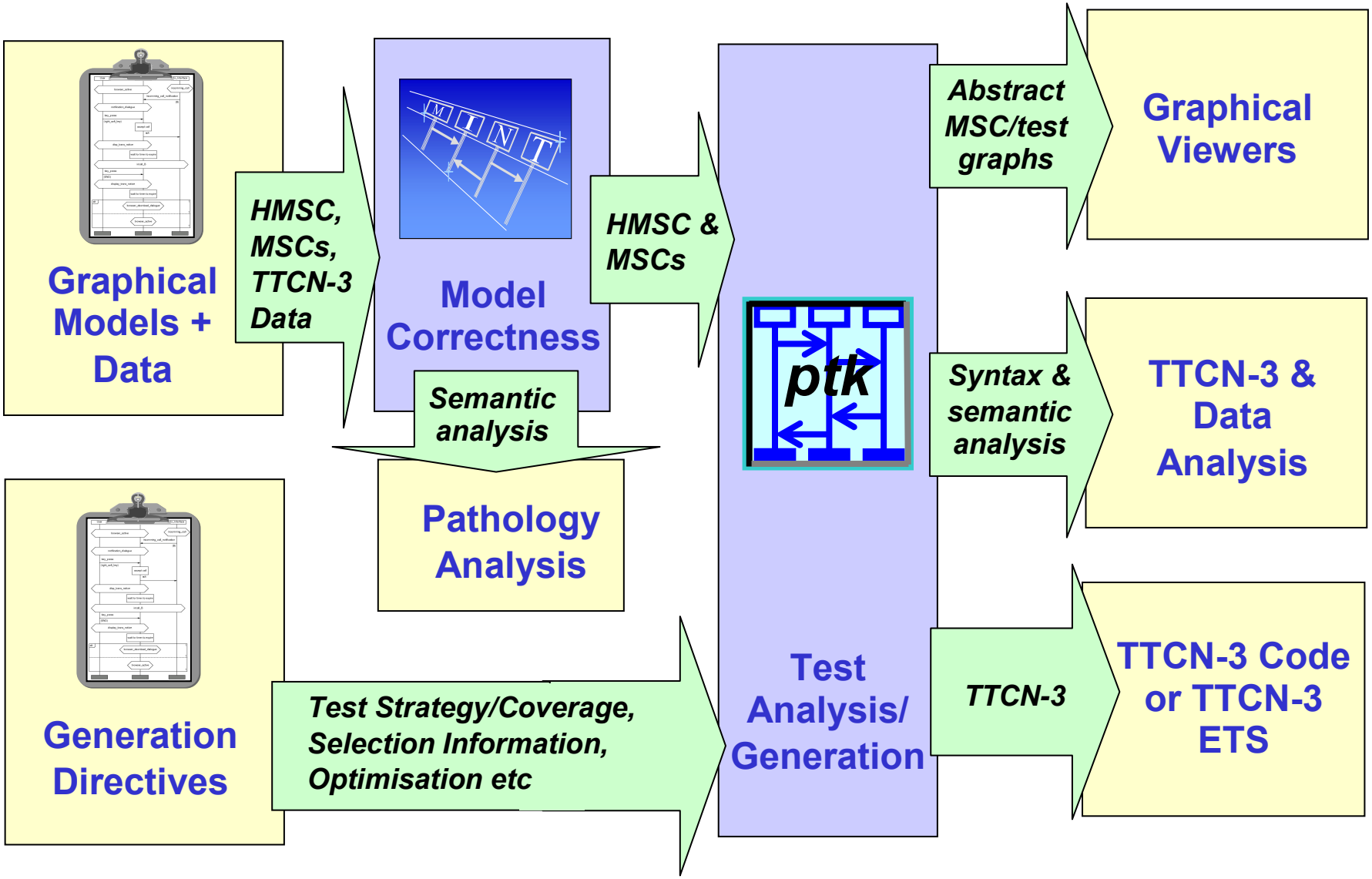


# Simple TTCN-3 Example



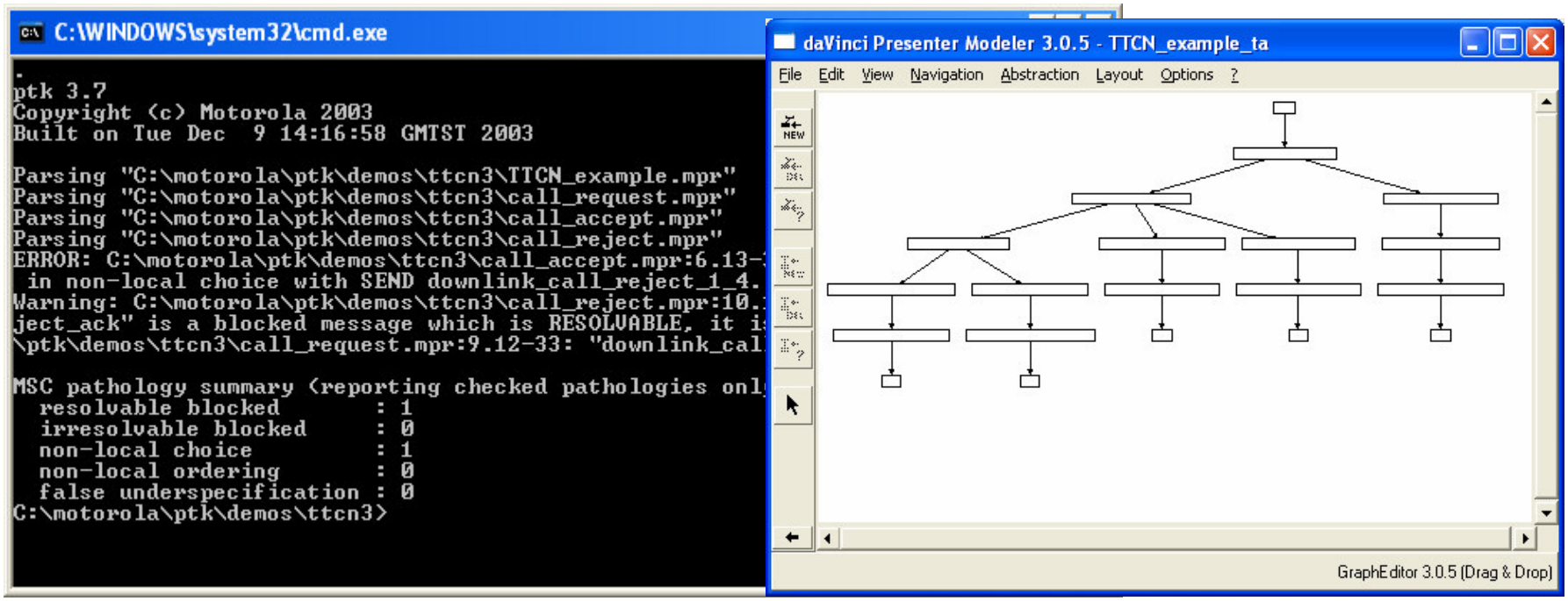

**Data language also needs to be considered. In this case MSC is parameterised with TTCN-3.**

# Example: Test Generation Process



# Example: Model Correctness/Test Analysis

- **Model semantics are represented in terms of traces**
  - Semantic analysis = 26 traces
  - Test analysis = 5 test traces
- **Model correctness identifies potential errors in the specification that can lead to invalid tests.**

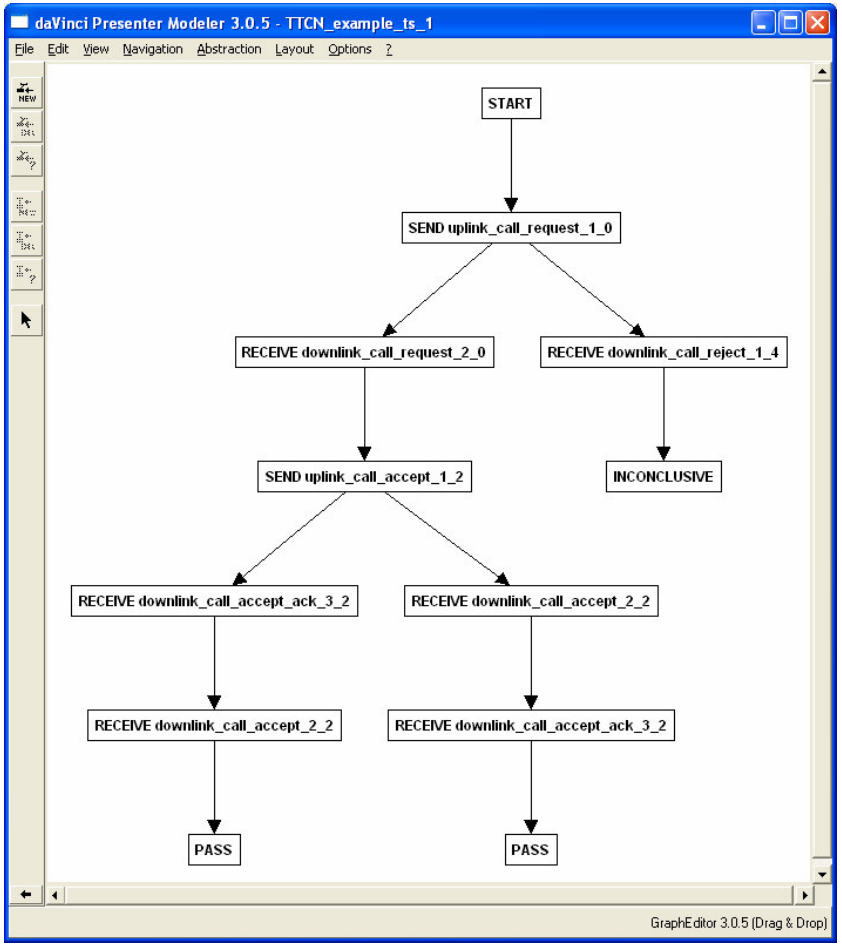


# Example: TTCN-3 Test Generation

- **Depending upon test generation directives a complete TTCN-3 suite can be generated.**

- **In this case we:**
  - Trade off path coverage vs no of test cases => 2 test cases
  - Only one test case may need to be executed => test control strategy
  - Useful tests produced

- **Generate TTCN-3 code**
  - Conformance tests
  - Concurrent test scripts
  - Load tests

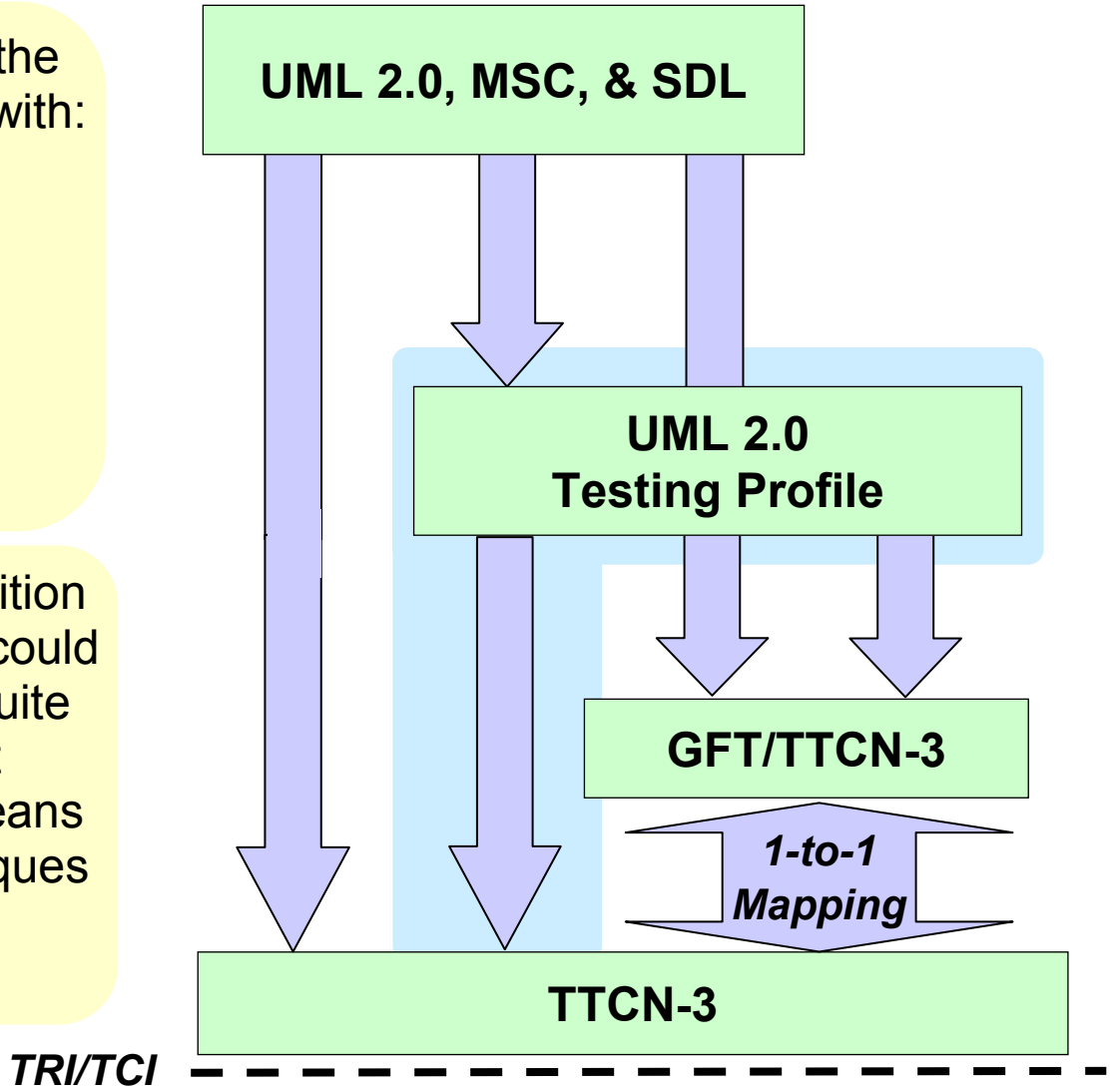


# Abstraction (2)

At this level of abstraction the user is usually concerned with:

- test cases
- test configuration
- verdict handling
- exception handling
- test control
- specification correctness

However, the level of definition can vary. For example, it could be that only a partial test suite is defined containing a test configuration only. This means that test generation techniques can be applied for missing aspects.



# Thank you

## Almost lunch time…

## – Questions?