6th UCAAT User Conference on Advanced Automated Testing

ETSI

Paris, 16-18 October 2018

Organizer: TESTING SOLUTIONS & SERVICES

# FROM TDL TO TTCN-3

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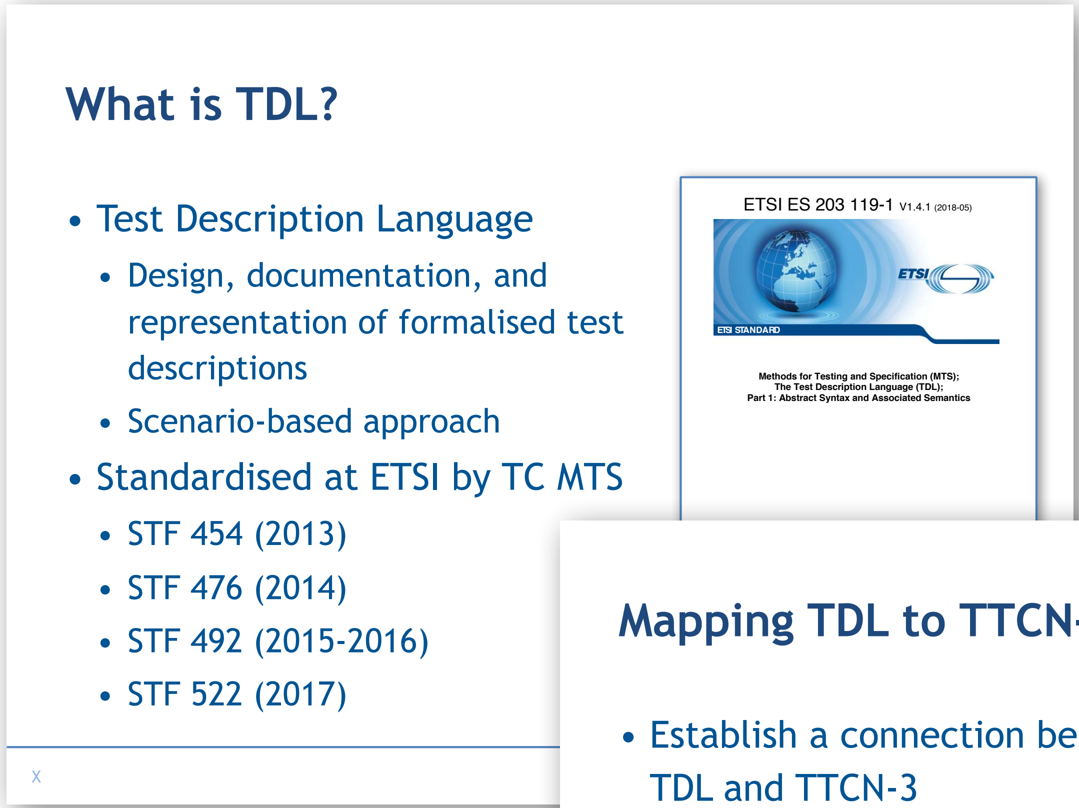
# Overview



## What is TDL?

- Test Description Language
  - Design, documentation, and representation of formalised test descriptions
  - Scenario-based approach
- Standardised at ETSI by TC MTS
  - STF 454 (2013)
  - STF 476 (2014)
  - STF 492 (2015-2016)
  - STF 522 (2017)

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 1: Abstract Syntax and Associated Semantics

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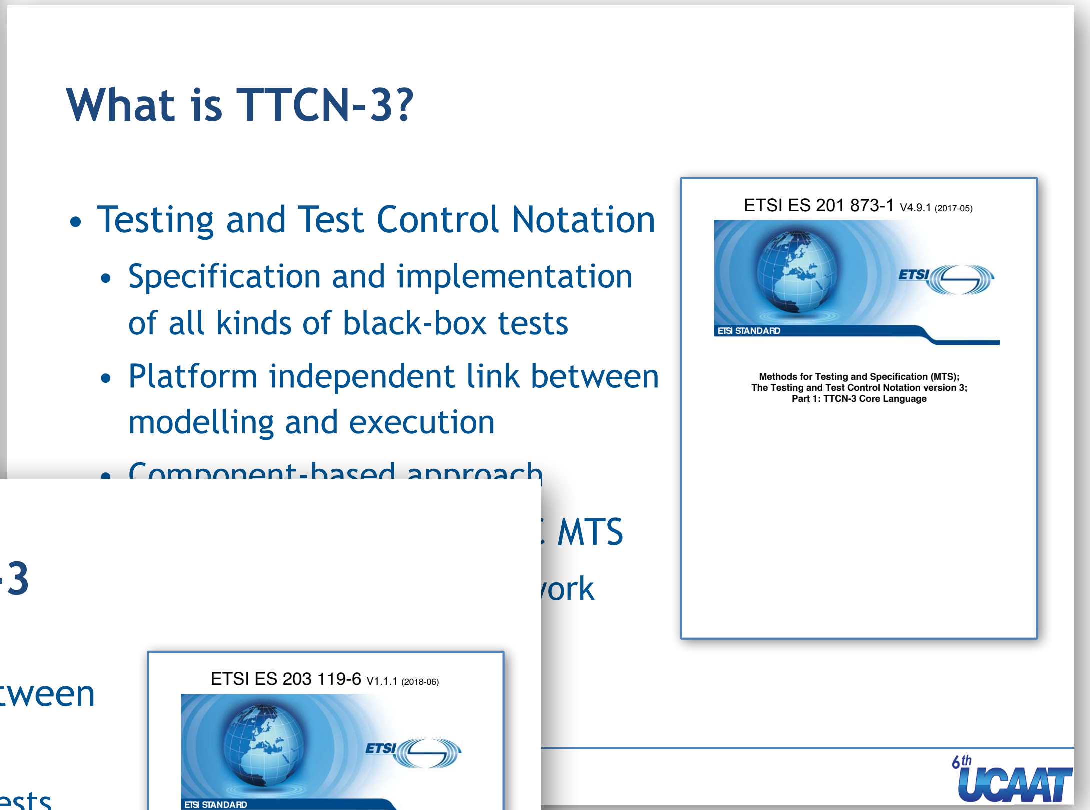

## What is TTCN-3?

- Testing and Test Control Notation
  - Specification and implementation of all kinds of black-box tests
  - Platform independent link between modelling and execution
  - Component-based approach

MTS

ork

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Testing and Test Control Notation version 3;
Part 1: TTCN-3 Core Language

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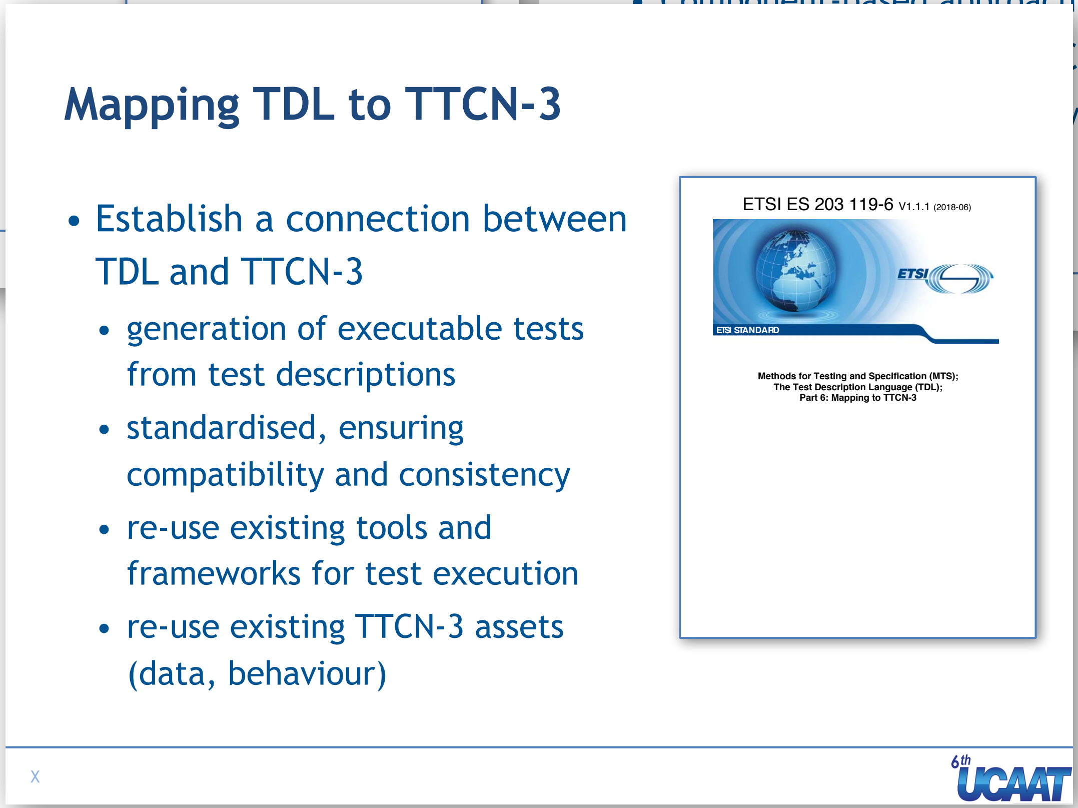

## Mapping TDL to TTCN-3

- Establish a connection between TDL and TTCN-3
  - generation of executable tests from test descriptions
  - standardised, ensuring compatibility and consistency
  - re-use existing tools and frameworks for test execution
  - re-use existing TTCN-3 assets (data, behaviour)

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

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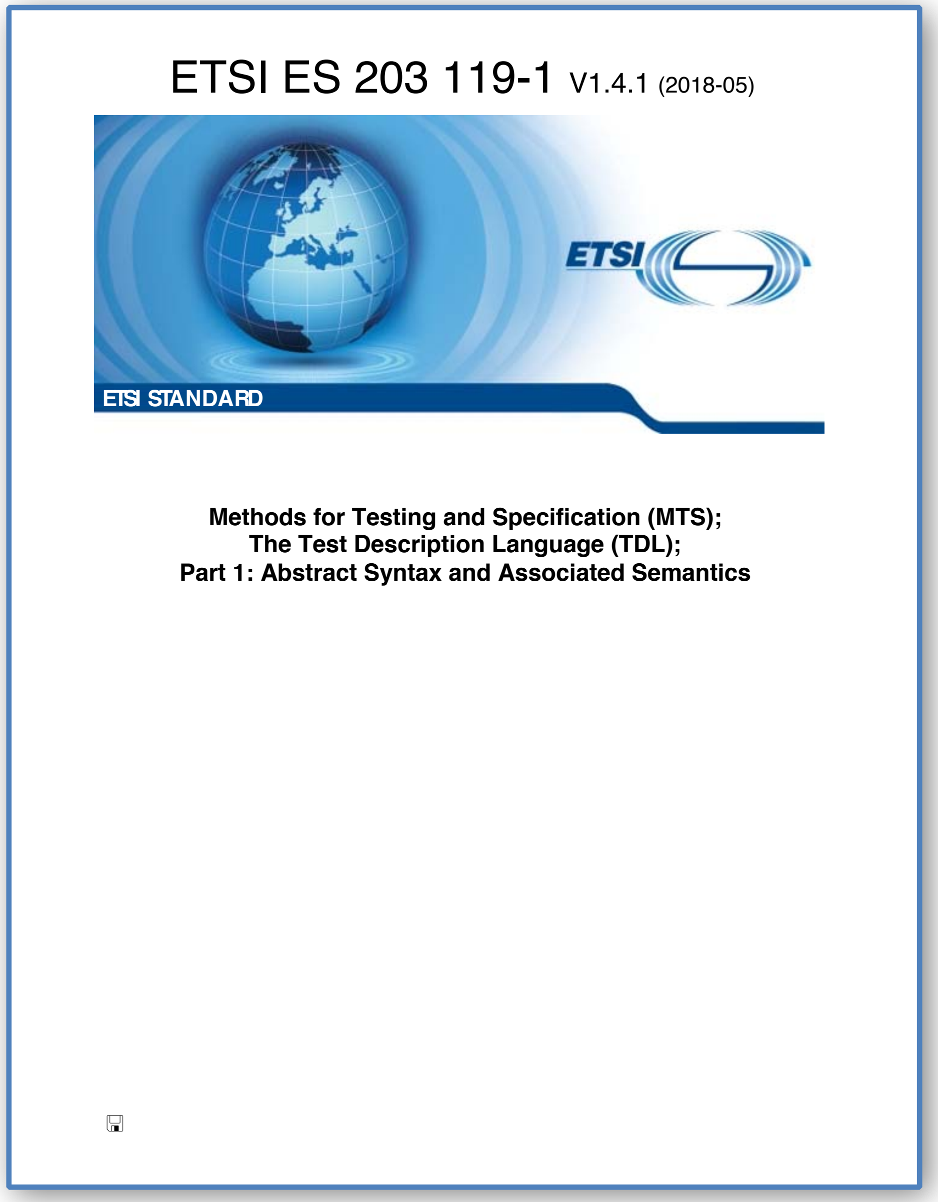
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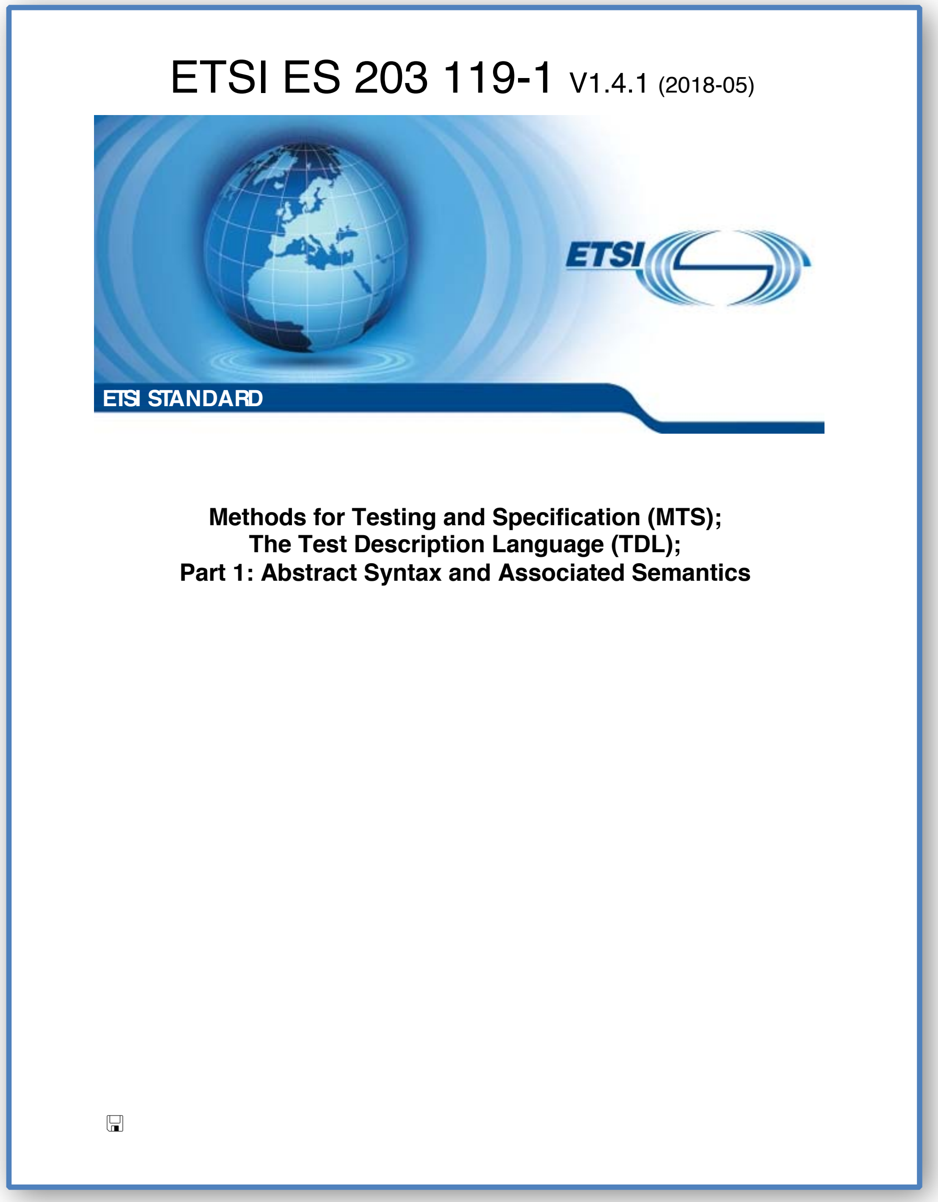
ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 1: Abstract Syntax and Associated Semantics**

## What is TDL?

- Design, documentation, representation?
  - ease development and review
  - improve productivity and quality
  - both industry and standardisation
  - reduce implementation details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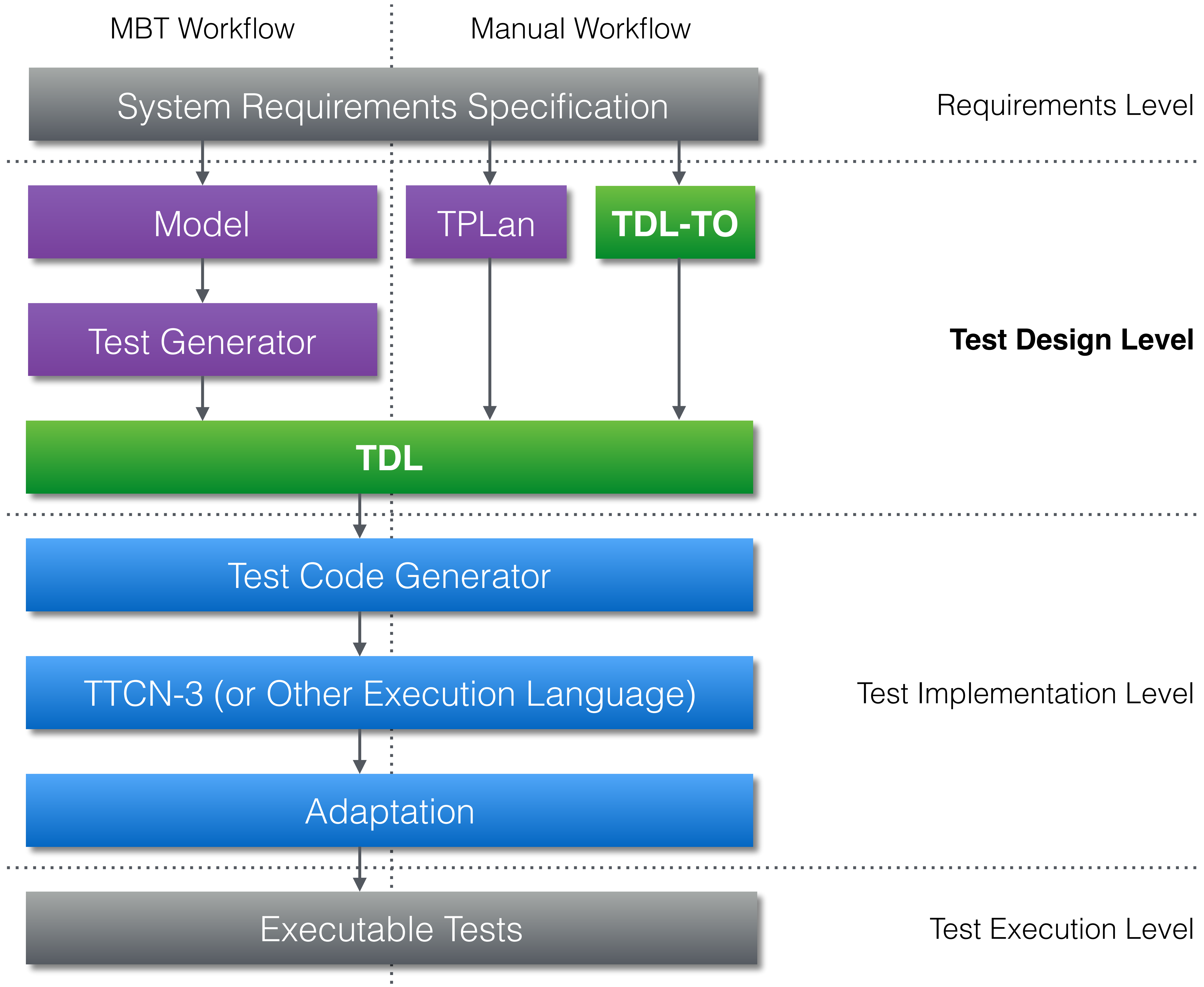
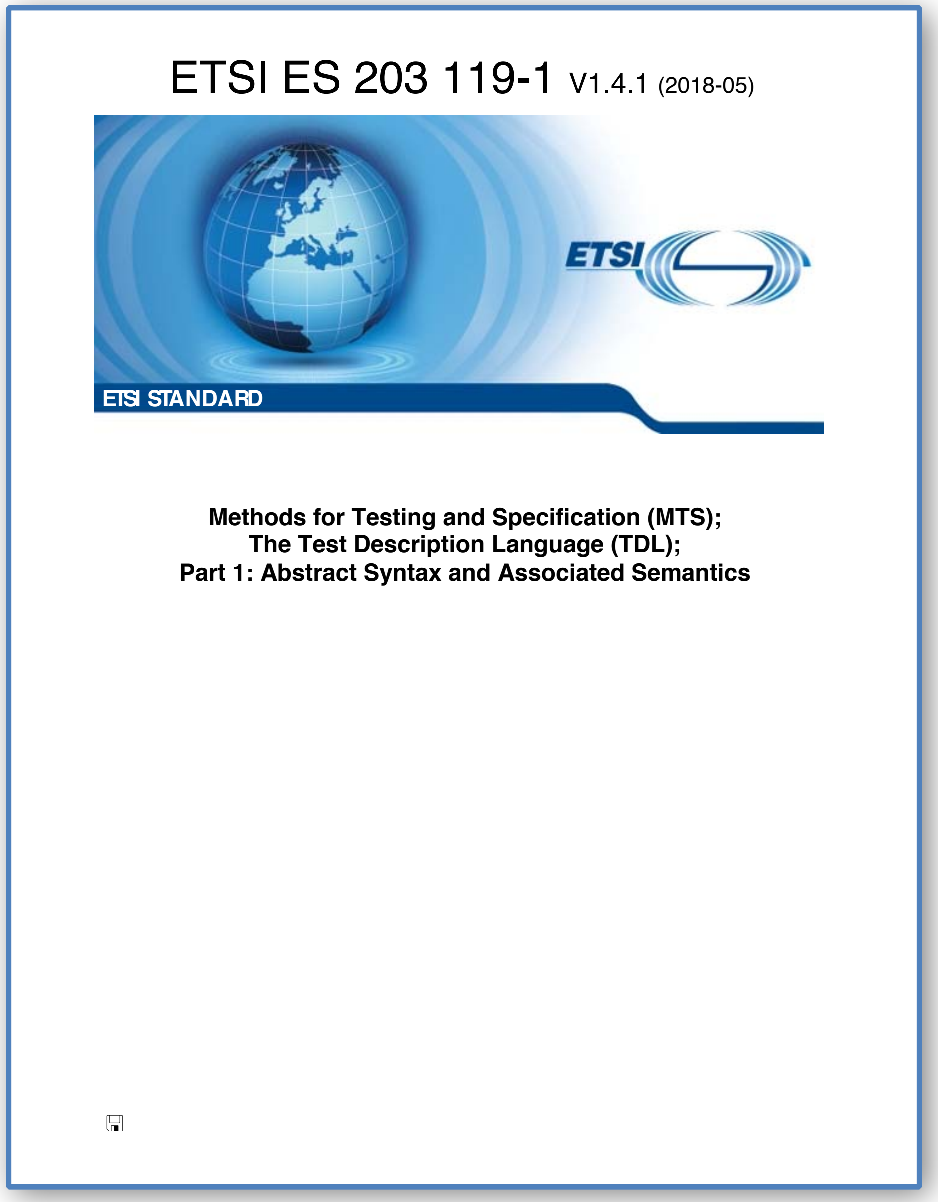

MBT Workflow
Manual Workflow
System Requirements Specification
Requirements Level
Model
TPLan
TDL-TO
Test Generator
Test Design Level
TDL
Test Code Generator
TTCN-3 (or Other Execution Language)
Test Implementation Level
Adaptation
Executable Tests
Test Execution Level

## What is TDL?

- Scenario-based?
  - describe interactions with a system
  - attach test objectives to scenarios
  - derive and automate tests
- Reactive, distributed, real-time
  - common black-box testing concepts
  - domain adaptation
  - agile development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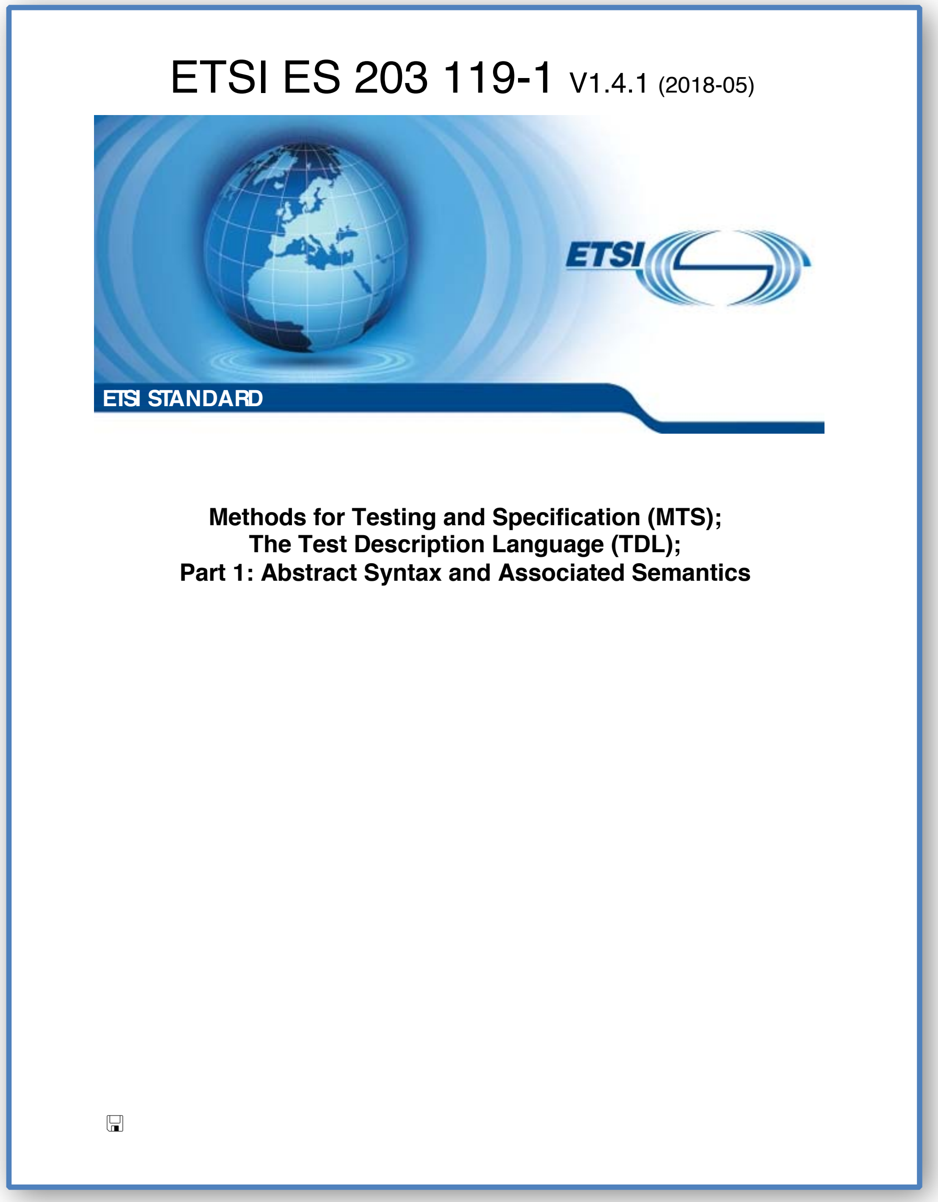
The Test Description Language (TDL);
Part 1: Abstract Syntax and Associated Semantics

## What is TDL?

- Standardised?
  - canonical reference
  - stable documentation
  - clear semantics
  - interoperability and independence
  - updated with user needs
  - maintenance commitment



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ETSI STANDARD

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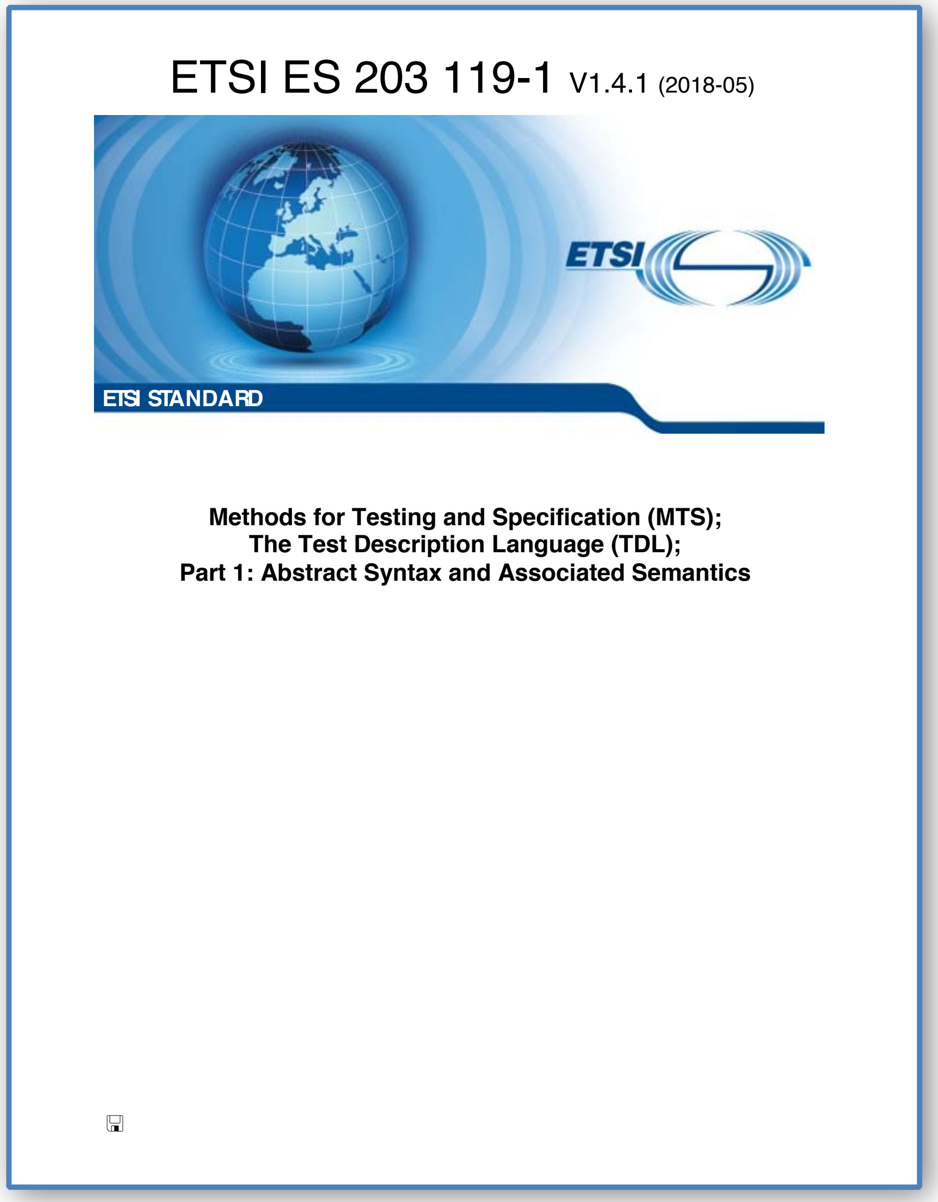
## What is TDL?

- Contributions from:
  - Siemens AG, Ericsson Hungary
  - Fraunhofer FOKUS, ETSI CTI
  - CEA, University of Göttingen
  - OU Elvior, Cinderella ApS
- Guidance:
  - Steering Group, TC MTS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Part 1: Abstract Syntax and Associated Semantics

# What is TDL?

Part 1: MM
Meta-Model
and Semantics

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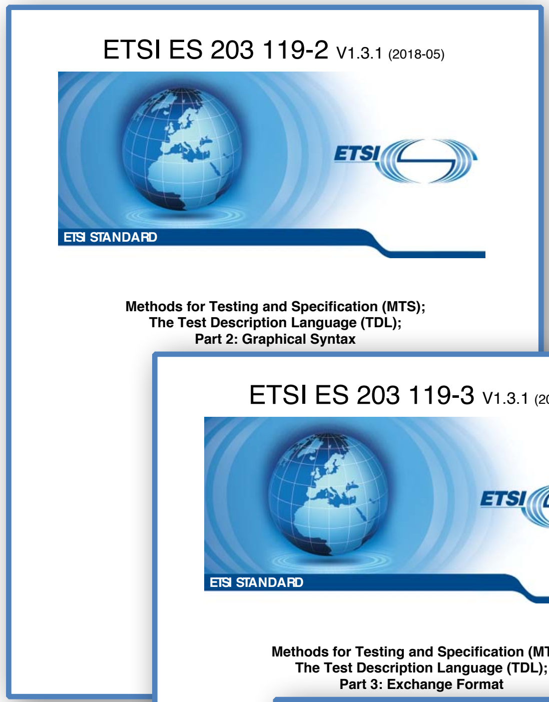
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The Test Description Language (TDL);
Part 2: Graphical Syntax

Part 2: GR
Graphical
Syntax

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 3: Exchange Format

Part 3: XF
Exchange
Format

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 4: Structured Test Objective Specification (Extension)

Part 4: TO
Structured
Test Objective
Specification

# What is TDL?

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ETSI STANDARD

Methods for Testing and Specification (MTS);
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Part 1: Abstract Syntax and Associated Semantics

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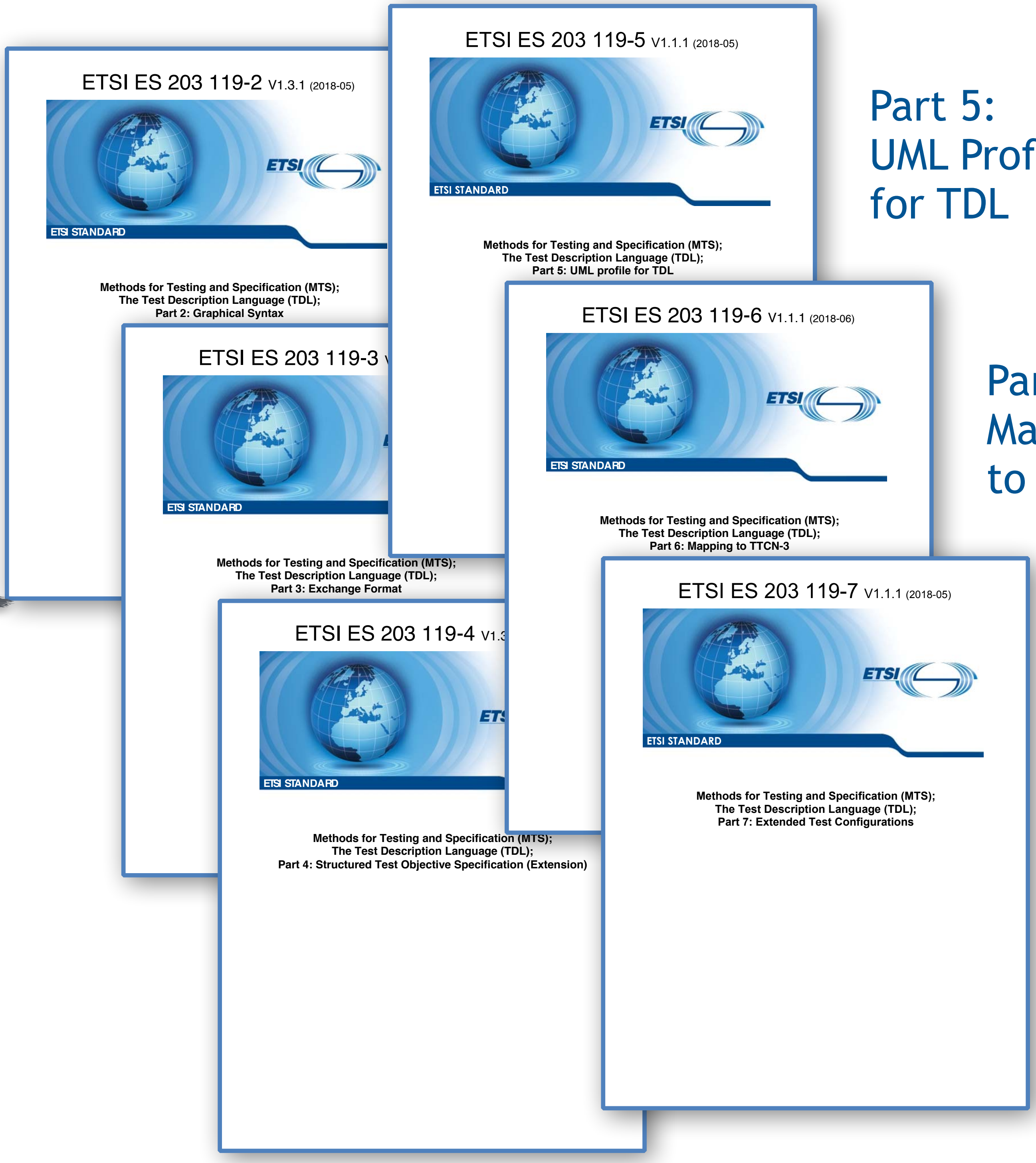

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Methods for Testing and Specification (MTS);
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Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 4: Structured Test Objective Specification (Extension)

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Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 5: UML profile for TDL

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Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

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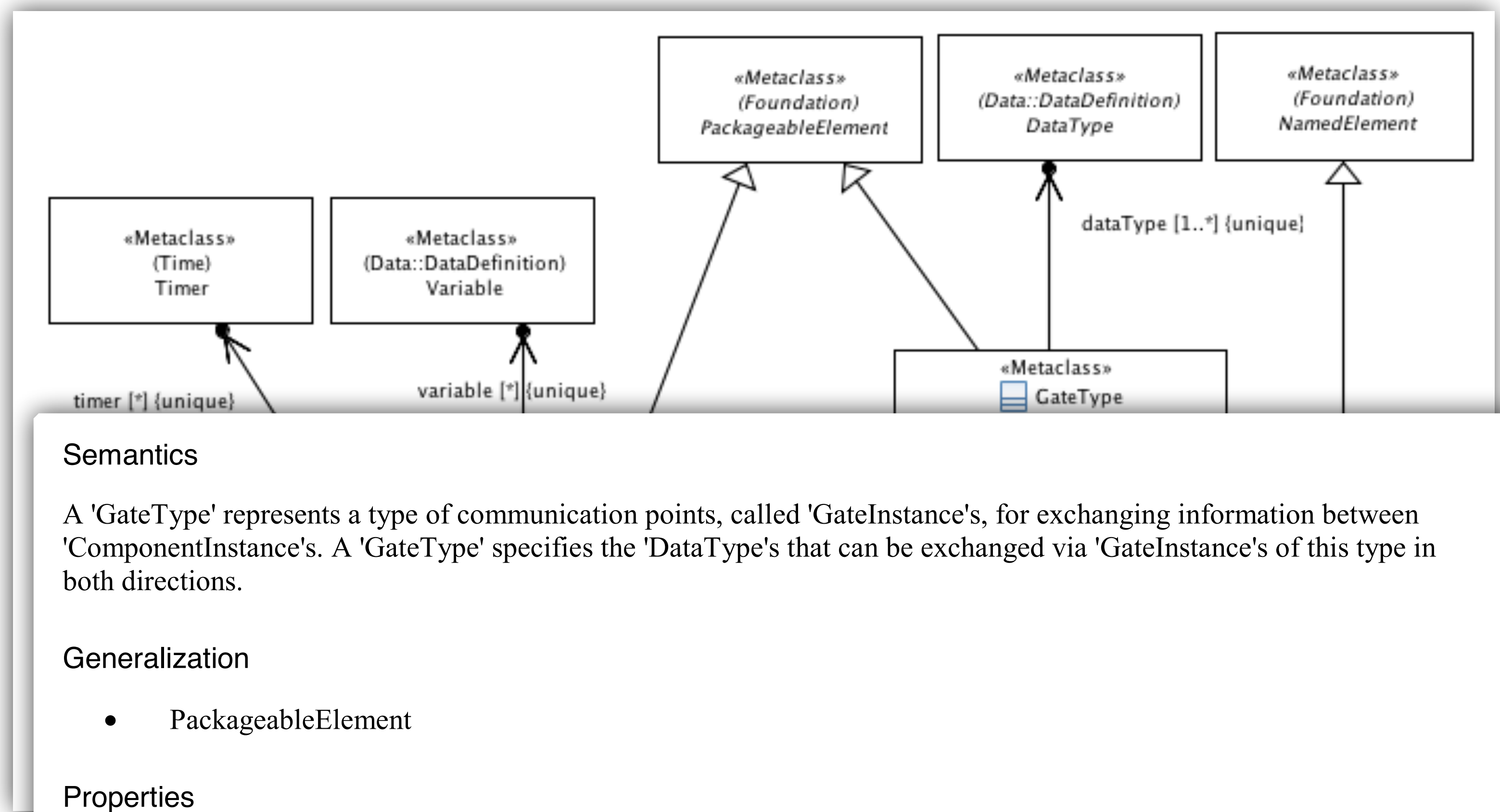
Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 7: Extended Test Configurations

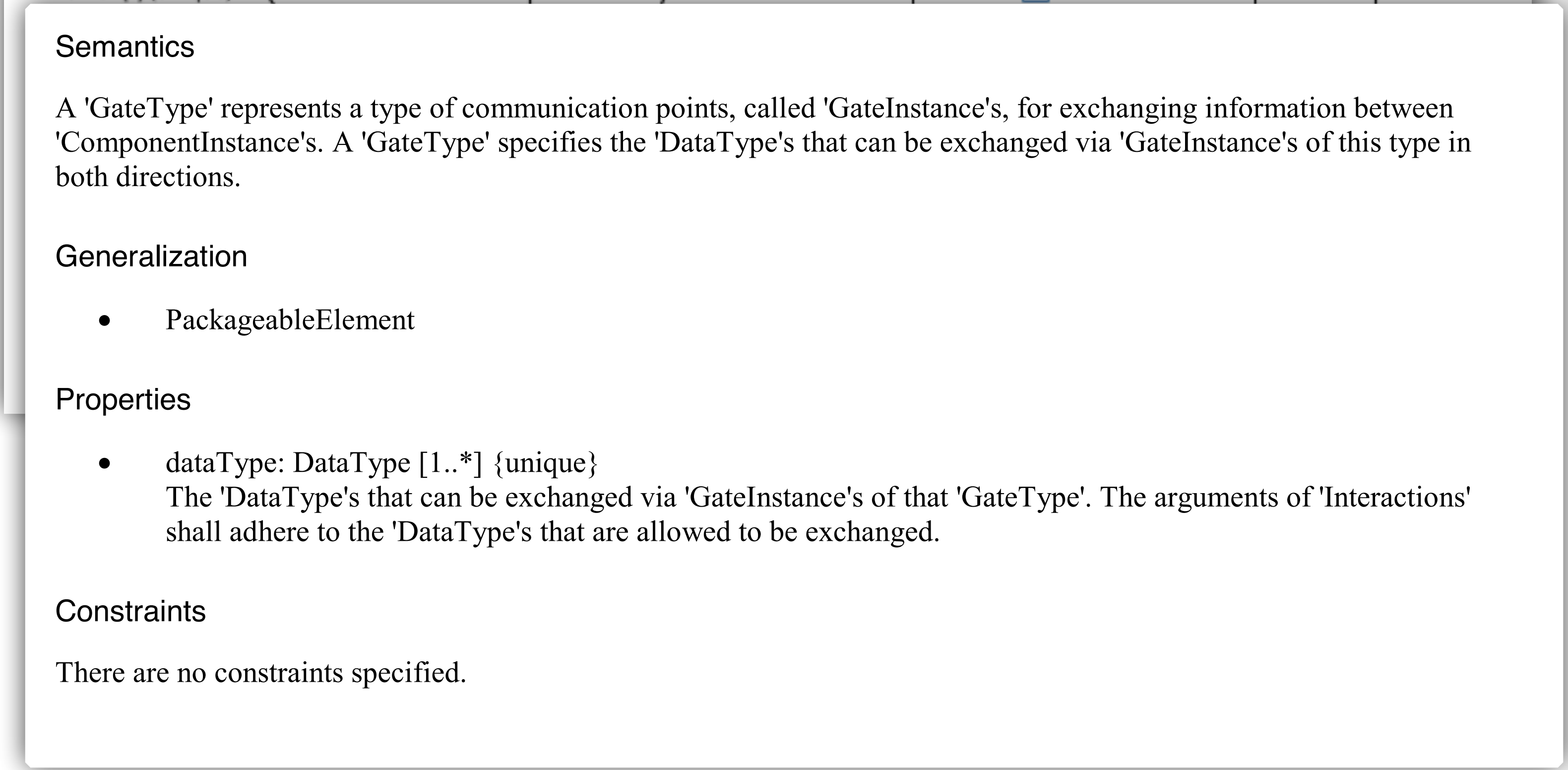
Part 5:
UML Profile
for TDL

Part 6:
Mapping
to TTCN-3

Part 7:
Extended
Test Configurations

## What is TDL?




Semantics

A 'GateType' represents a type of communication points, called 'GateInstance's, for exchanging information between 'ComponentInstance's. A 'GateType' specifies the 'DataType's that can be exchanged via 'GateInstance's of this type in both directions.

Generalization

- PackageableElement

Properties

- dataType: DataType [1..*] {unique}
  The 'DataType's that can be exchanged via 'GateInstance's of that 'GateType'. The arguments of 'Interactions' shall adhere to the 'DataType's that are allowed to be exchanged.

Constraints

There are no constraints specified.

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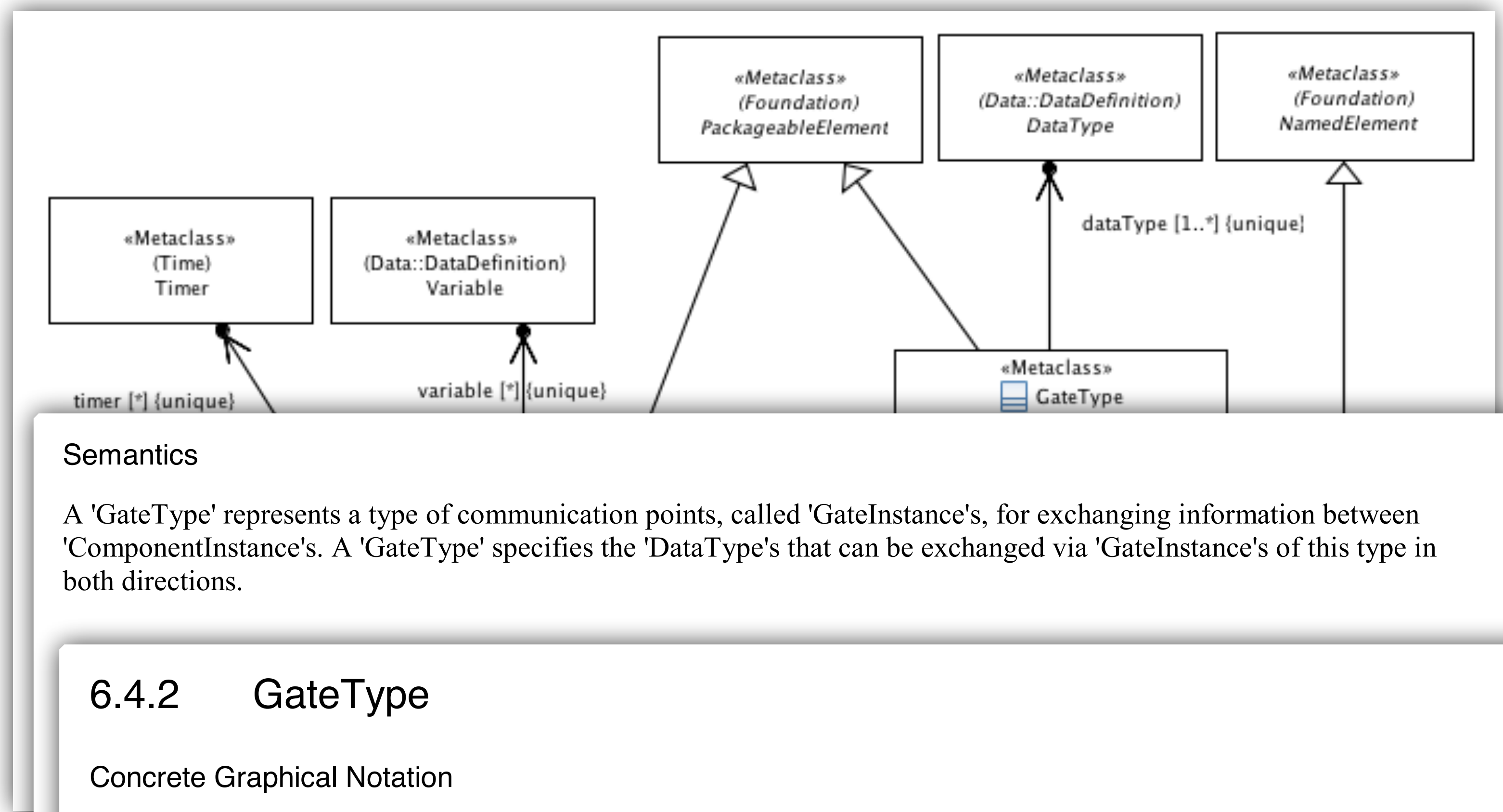
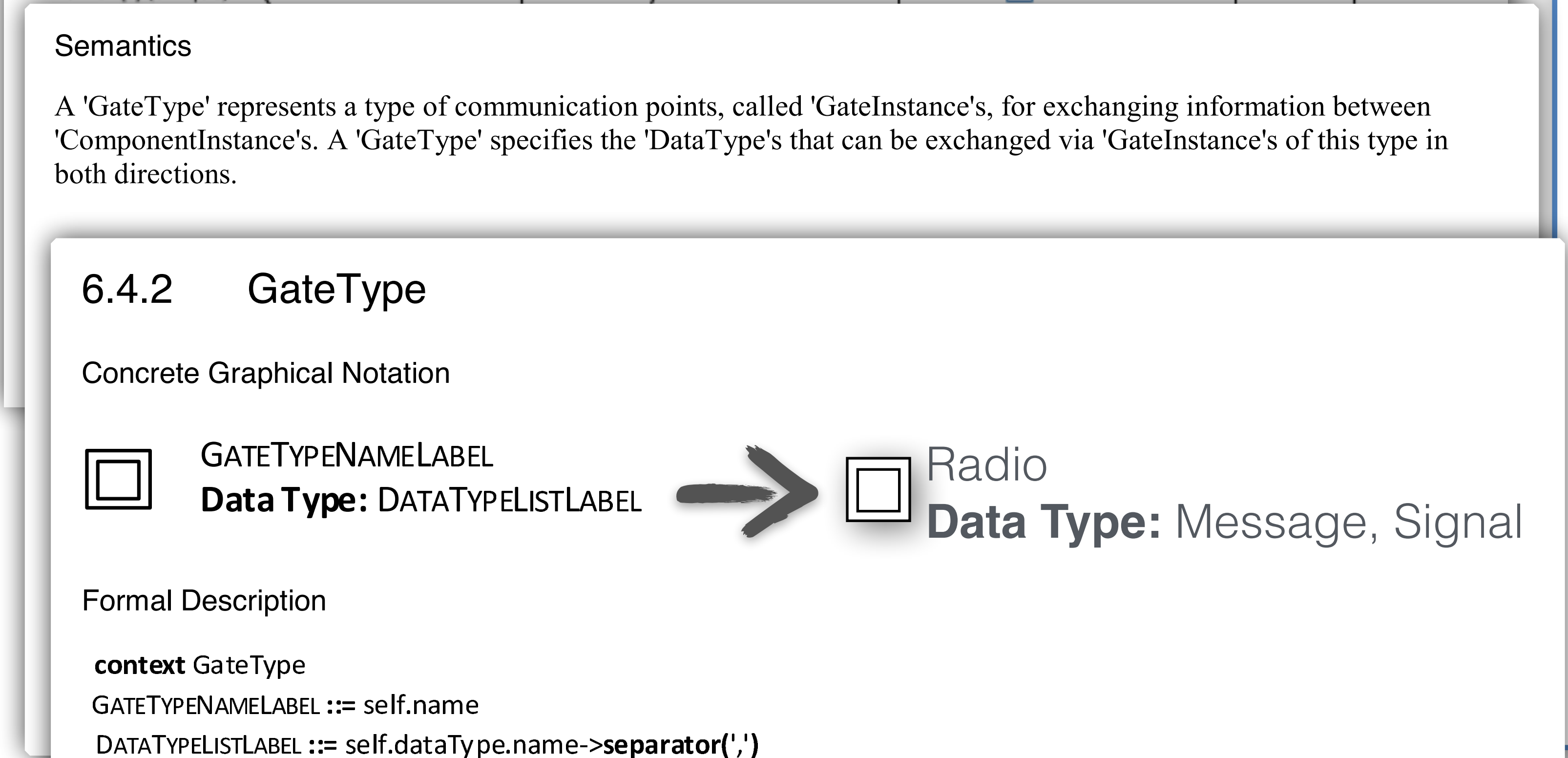
# What is TDL?


«Metaclass» (Foundation) PackageableElement
«Metaclass» (Data::DataDefinition) DataType
«Metaclass» (Foundation) NamedElement
«Metaclass» (Time) Timer
«Metaclass» (Data::DataDefinition) Variable
dataType [1..*] {unique}
timer [*] {unique}
variable [*] {unique}
«Metaclass» GateType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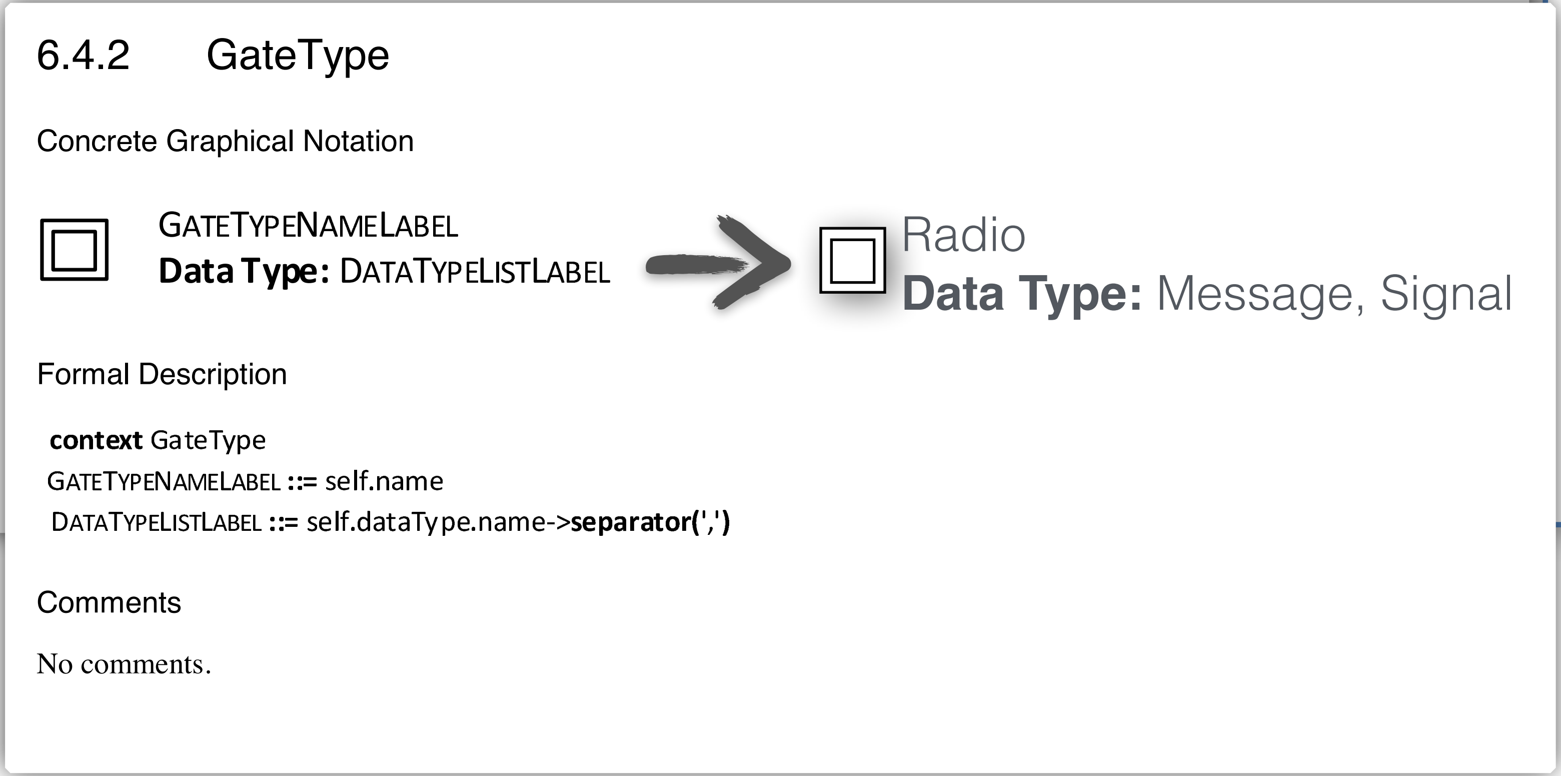

6.4.2 GateType

Concrete Graphical Notation

GATETYPENAMELABEL
**Data Type:** DATATYPELISTLABEL

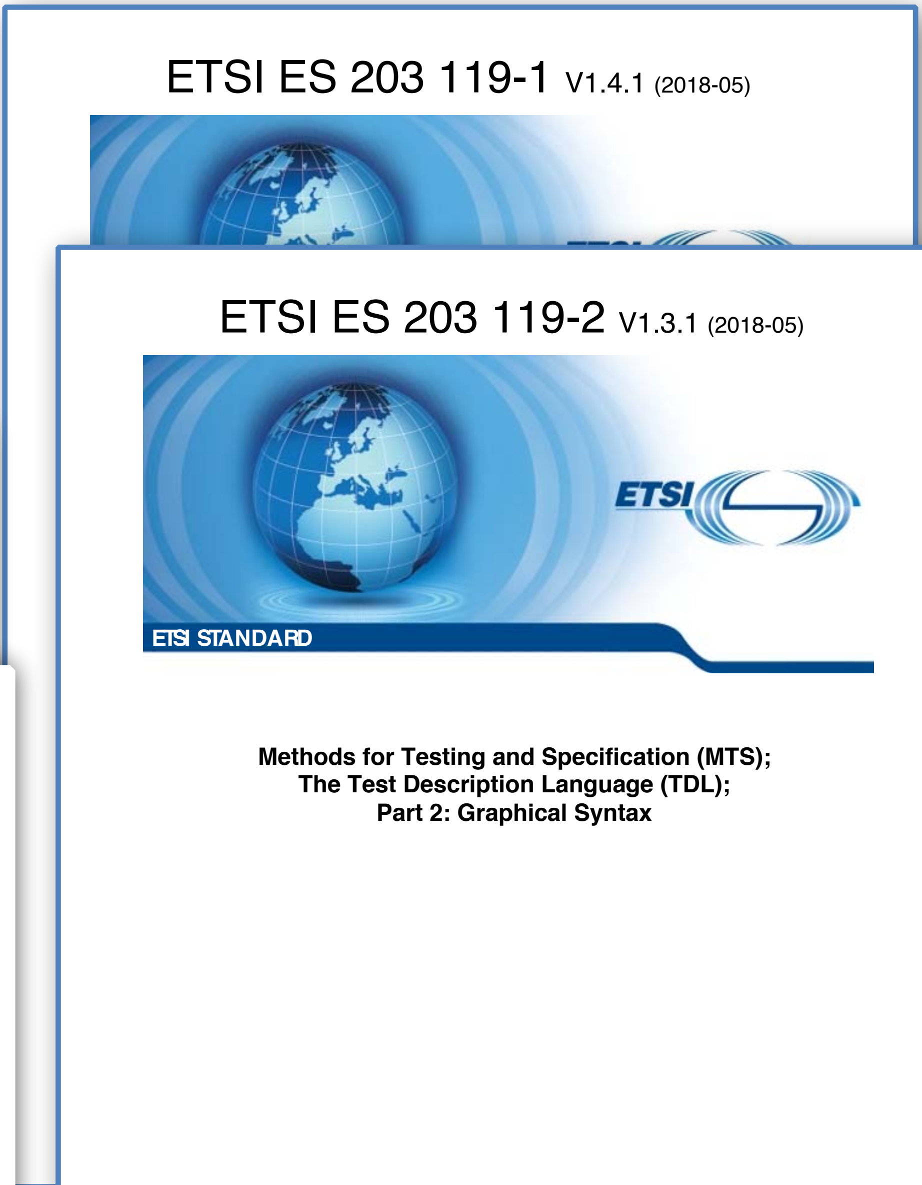
Radio
**Data Type:** Message, Signal

Formal Description

**context** GateType
GATETYPENAMELABEL ::= self.name
DATATYPELISTLABEL ::= self.dataType.name->**separator**(',')

Comments

No comments.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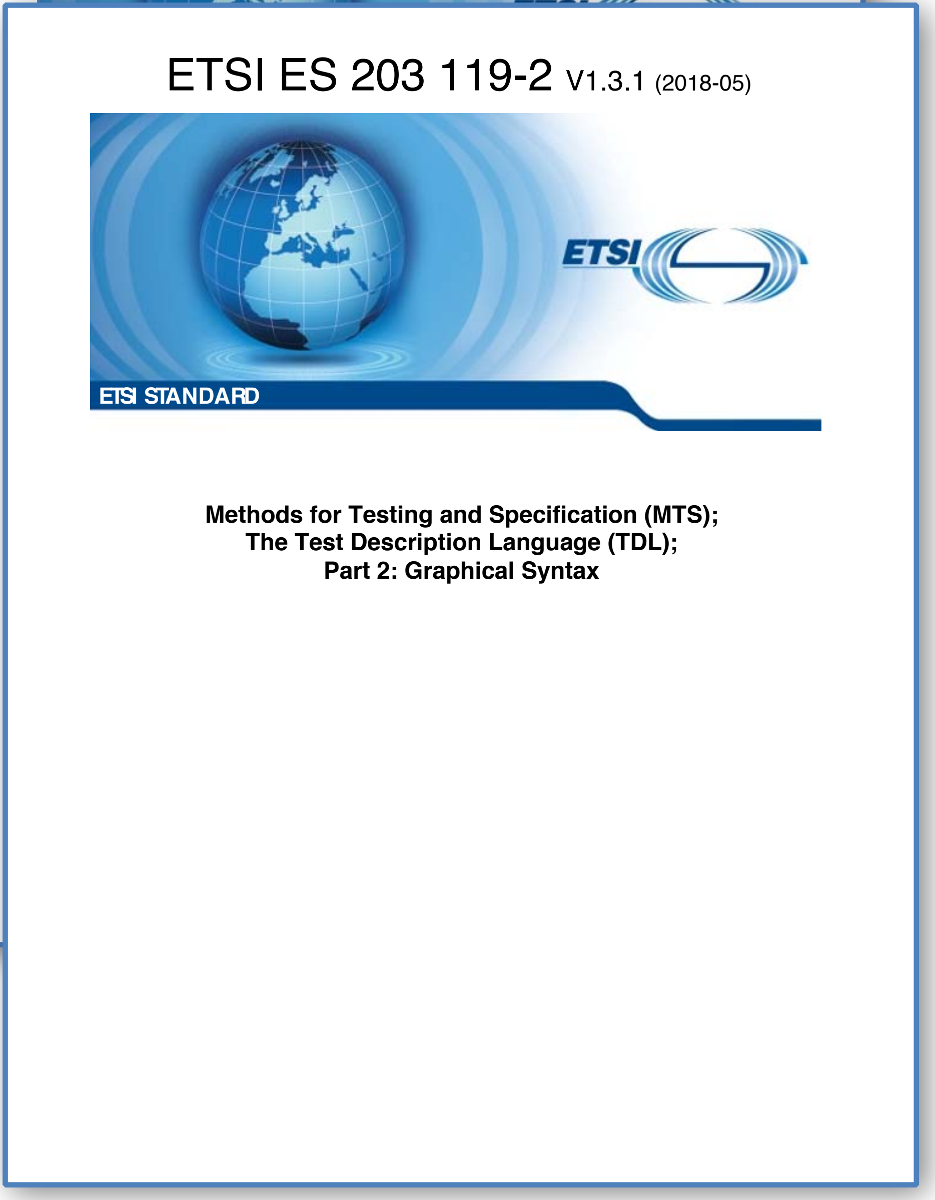
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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
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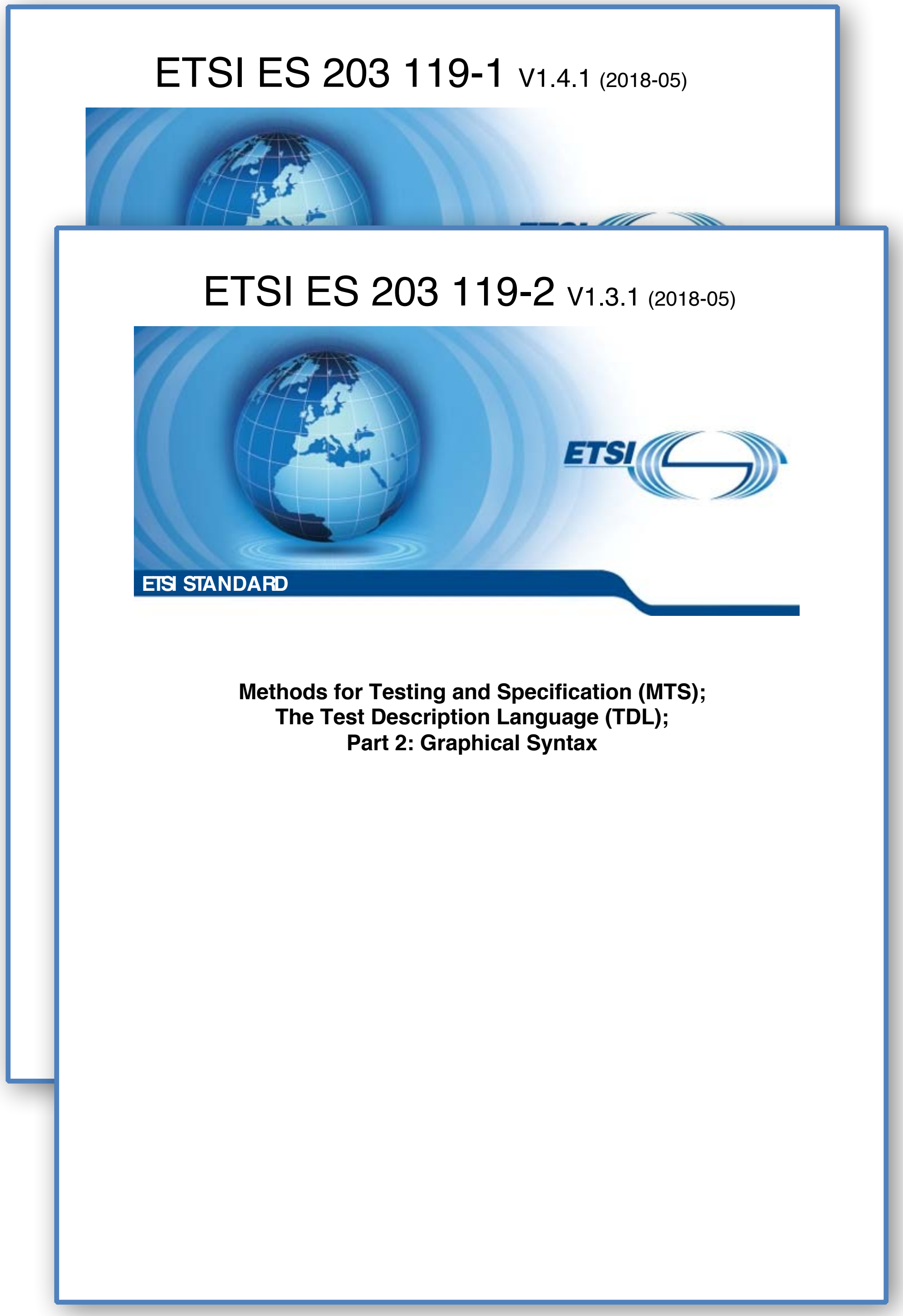
**Part 2: Graphical Syntax**

## What is TDL?

- TDL main ingredients
  - Test data
  - Test configuration
  - Test behaviour
  - Test objectives
  - Time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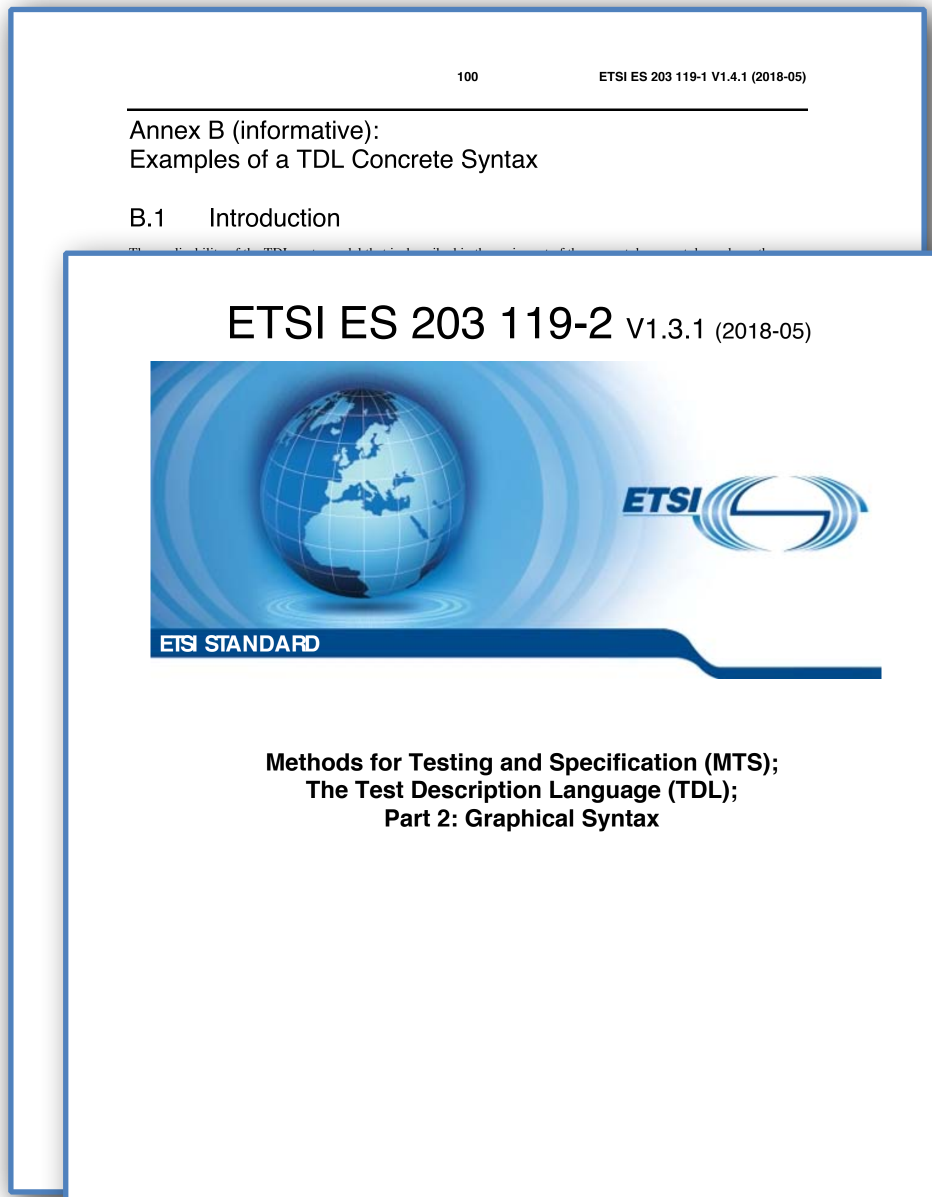
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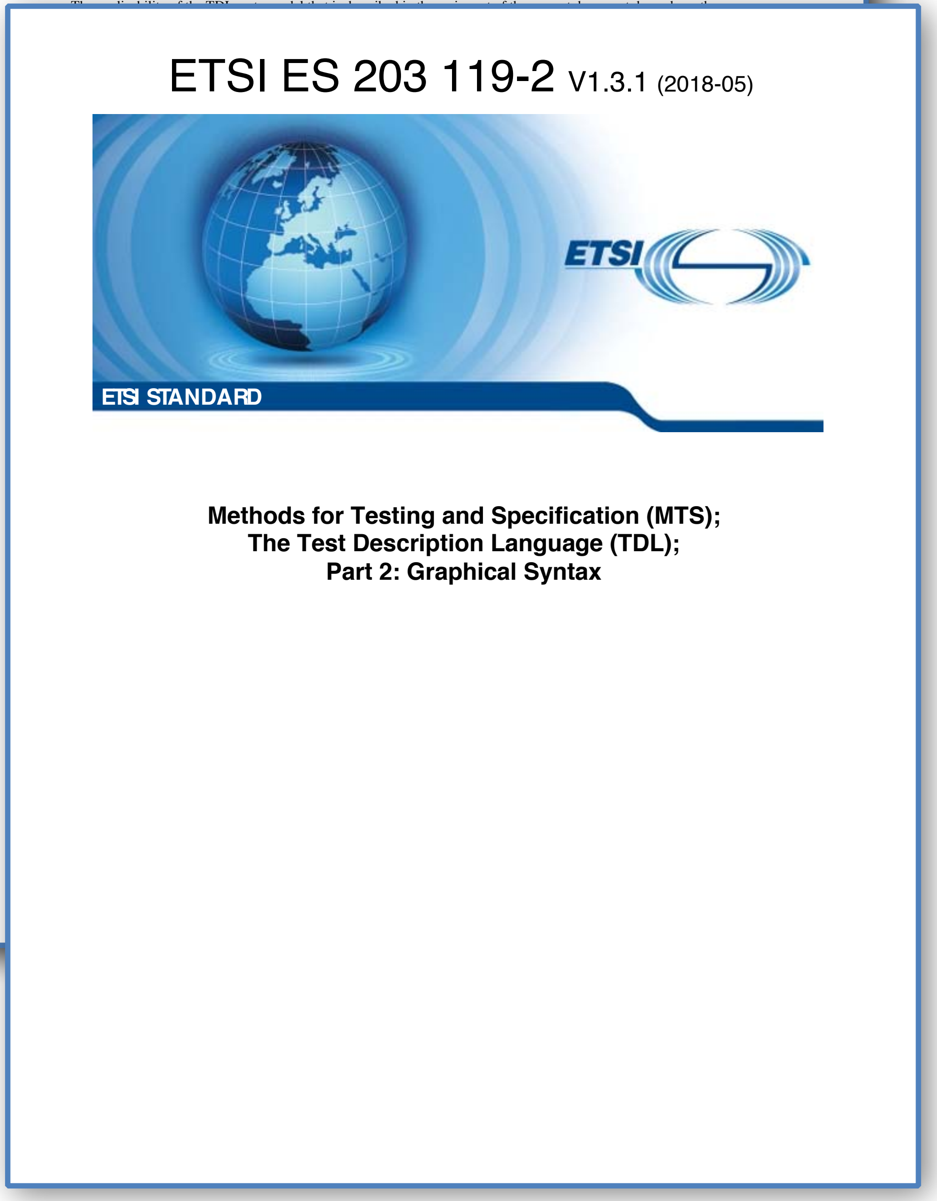
Annex B (informative):
Examples of a TDL Concrete Syntax

B.1 Introduction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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
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**Part 2: Graphical Syntax**

## Main Ingredients

- Test data
  - data definition and data use
  - abstract types and instances
  - composed by using parameters
  - functions and actions
  - mappable to concrete data
  - variables and special values

# Test Data

Test Design

```
Type Login;
Login correct;
Login incorrect;

Use "data.ttcn3" as DATA ;
Map correct to "johnny_correct" in DATA as correct_ttcn3;
Map incorrect to "johnny_incorrect" in DATA as incorrect_ttcn3;
```

Test Implementation

```
template Login johnny_correct := {
    user := "johnny",
    password := "apple",
    hint := "seed",
    id := 1000
}
template Login johnny_incorrect := {
    user := "johnny",
    password := "orange",
    hint := "second favourite fruit",
    id := 2000
}
```

```
type record Login {
  charstring user,
  charstring password,
  charstring hint,
  integer id
} with {
  encode "xpath=//div[@id='login']";
  encode (user) "relative=/div/dd[3]";
  encode (password) "relative=/div/dd[4]";
};
```

# Test Data

```
Type Login;
Login correct;
Login incorrect;

Use "data.ttcn3" as DATA ;
Map correct to "johnny_correct" in DATA as correct_ttcn3;
Map incorrect to "johnny_incorrect" in DATA as incorrect_ttcn3;
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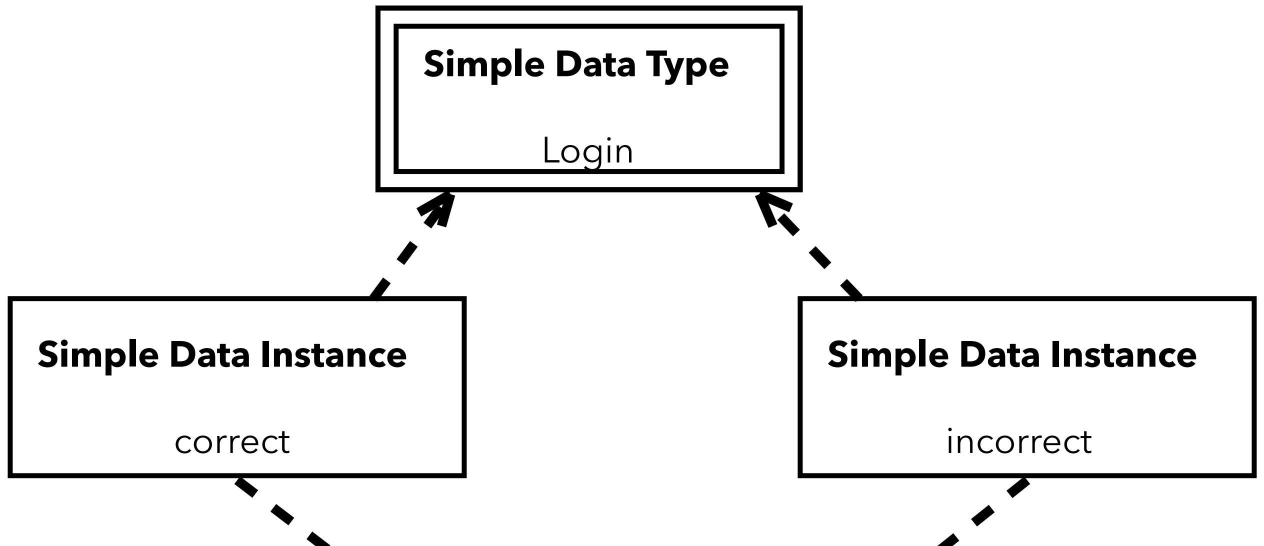
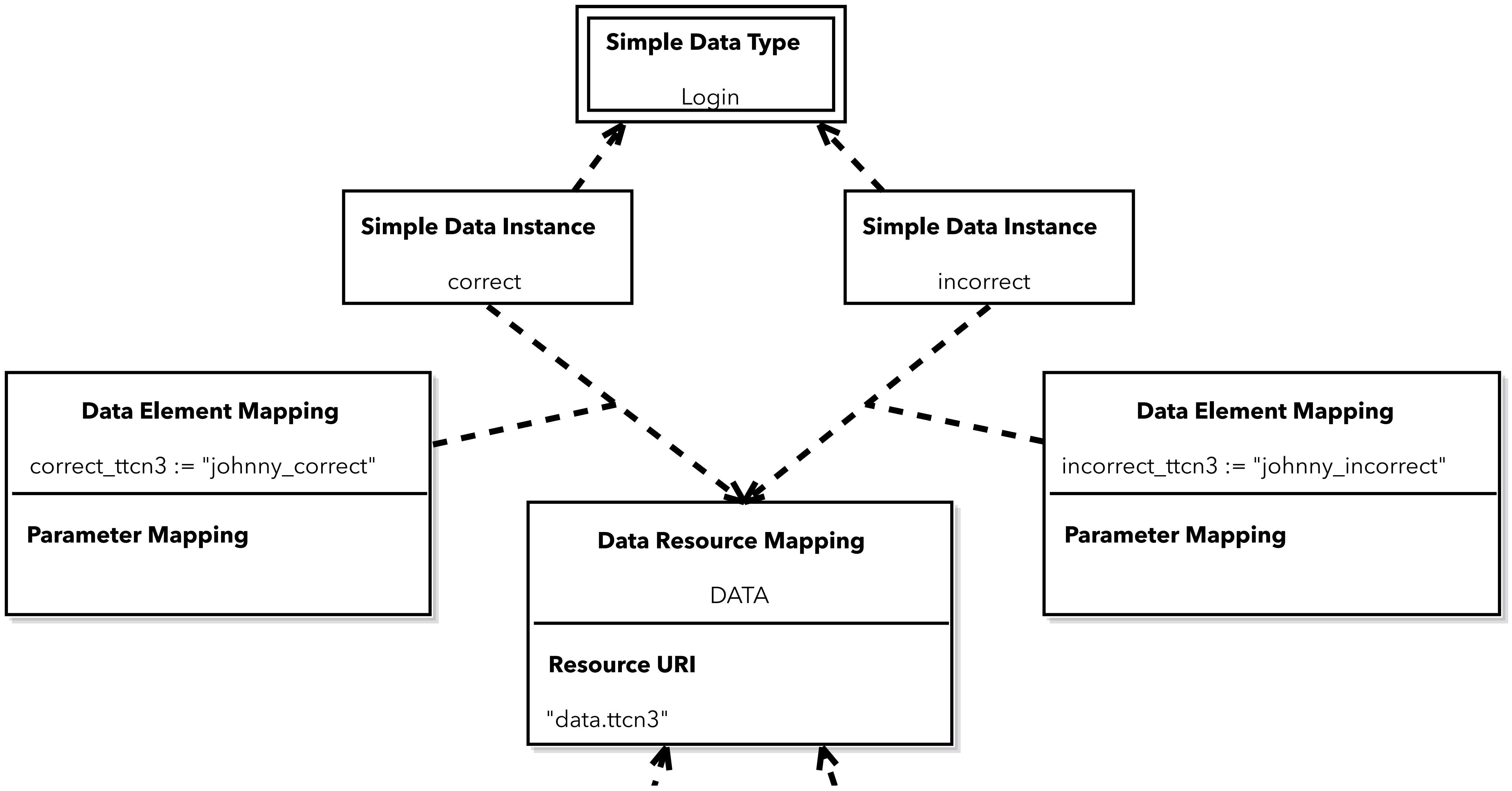


## Test Data


Simple Data Type
Login
Simple Data Instance
correct
Simple Data Instance
incorrect
Data Element Mapping
correct_ttcn3 := "johnny_correct"
Parameter Mapping
Data Resource Mapping
DATA
Resource URI
"data.ttcn3"
Data Element Mapping
incorrect_ttcn3 := "johnny_incorrect"
Parameter Mapping

## Main Ingredients

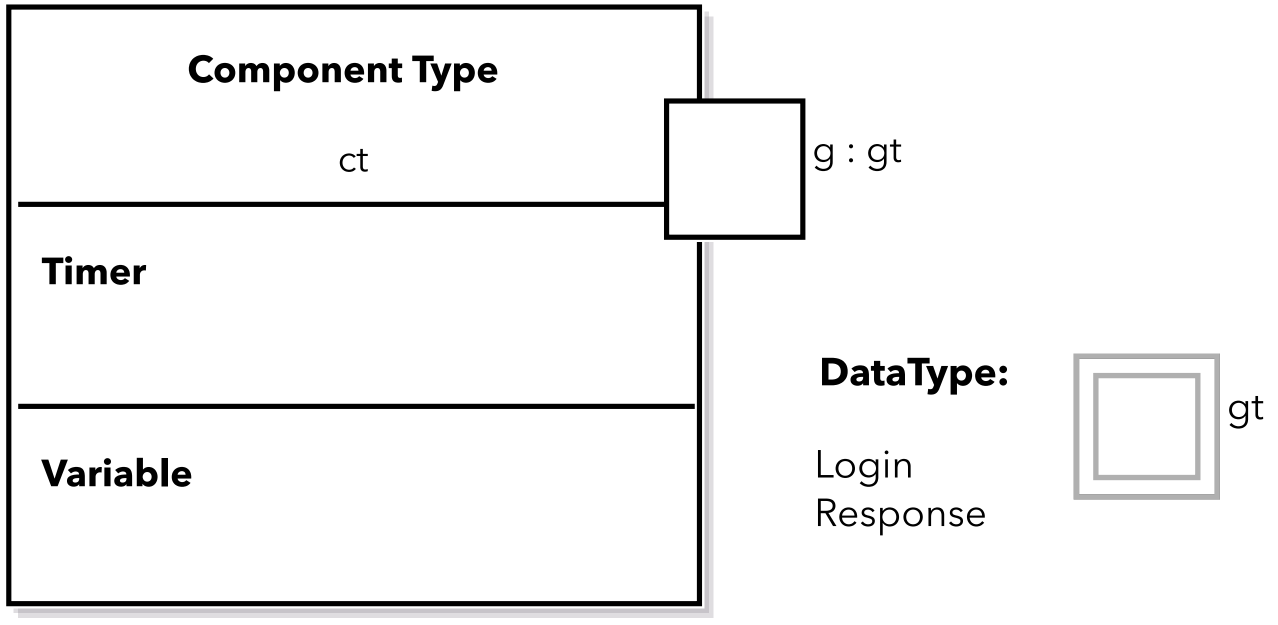
- Test configuration
  - typed components and gates
  - timers and variables
  - connections among gates
  - component roles

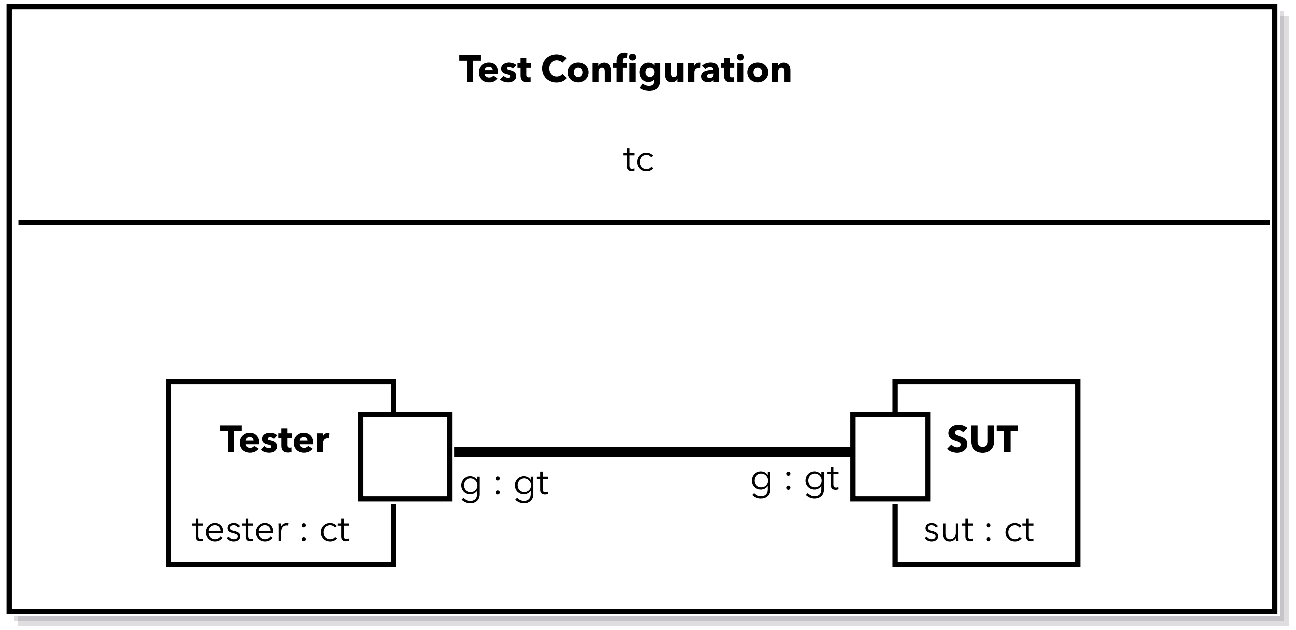
## Test Configuration

```
Gate Type gt accepts Login, Response;

Component Type ct having {
    gate g of type gt;
}

Test Configuration tc {
    create Tester tester of type ct;
    create SUT sut of type ct;
    connect tester.g to sut.g;
}
```





## Main Ingredients

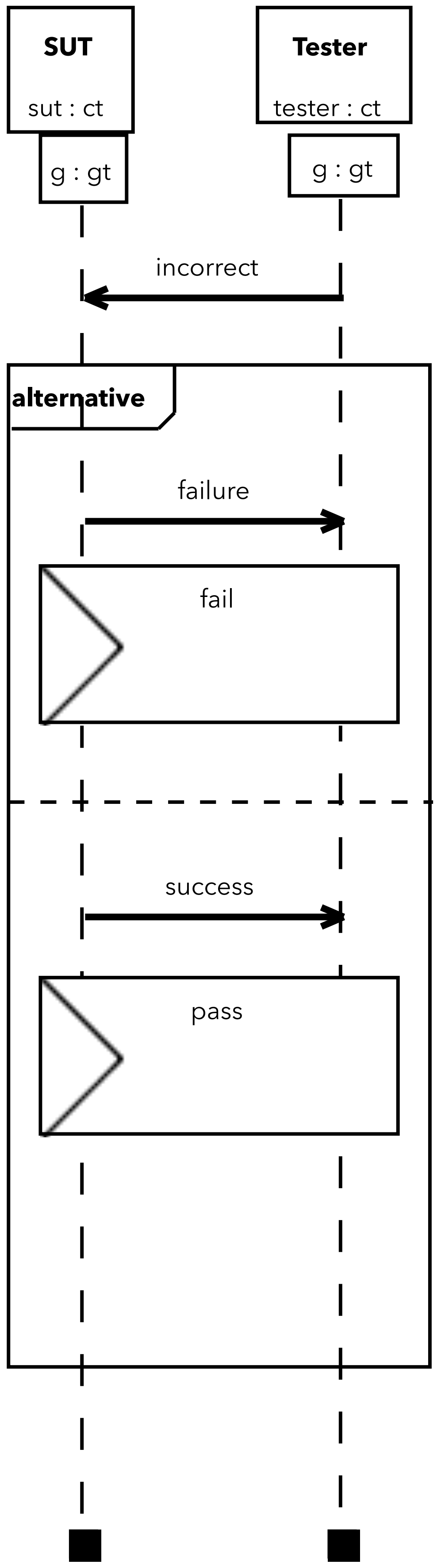
- Test behaviour
  - defines expected behaviour
  - failure upon deviations by default
  - actions and interactions
  - alternative, parallel, iterative, conditional
  - defaulting, interrupting, breaking

## Test Behaviour

```
Test Description td (p of type Login)
  uses configuration tc {
    tester.g sends incorrect to sut.g;
    alternatively {
        sut.g sends failure to tester.g with {
            test objectives : tp;
        };
        set verdict to pass;
    } or {
        sut.g sends success to tester.g;
        set verdict to fail;
    }
}
```

or simply (relying on the default semantics):

```
Test Description td_default (p of type Login)
  uses configuration tc {
    tester.g sends incorrect to sut.g;
    sut.g sends failure to tester.g with {
        test objectives : tp;
    };
}
```



## Main Ingredients

- Test objectives
  - may be attached to
    - behaviour (atomic or compound)
    - whole test description
  - contain description and reference

# Test Objectives

```
Test Objective tp {
    description : "ensure that
                   when incorrect login is provided
                   a failure response is sent";
}
Test Description td (p of type Login)
  uses configuration tc {
    tester.g sends incorrect to sut.g;
    alternatively {
        sut.g sends failure to tester.g;
        set verdict to pass;
    } or {
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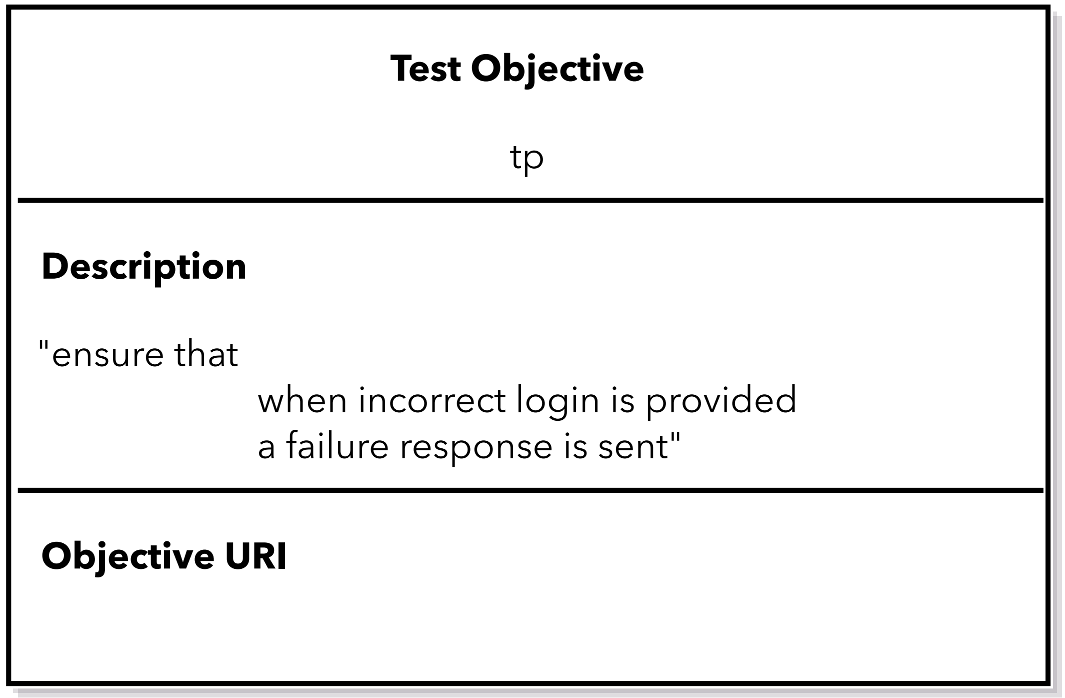
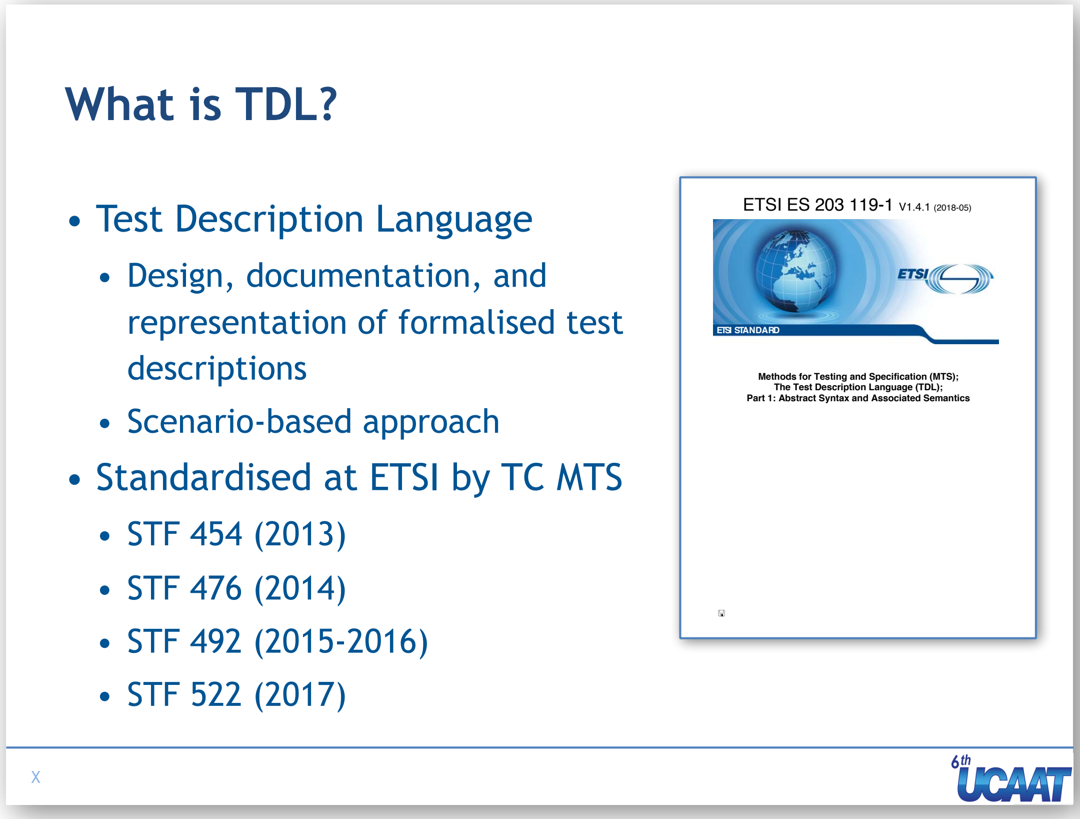
        set verdict to fail;
    }
} with {
    test objectives : tp;
}
```



| Test Objective<br>tp |
|---|
| **Description**<br>"ensure that<br>when incorrect login is provided<br>a failure response is sent" |
| **Objective URI** |

## Overview



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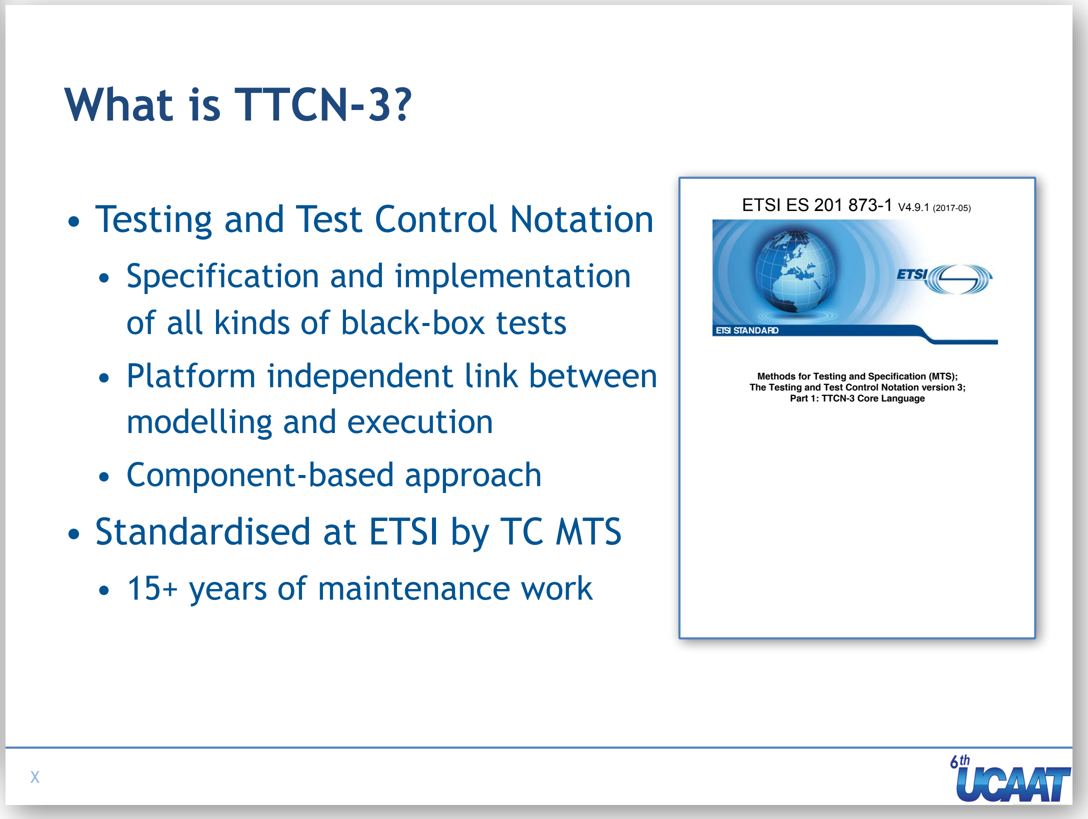

### What is TTCN-3?

- Testing and Test Control Notation
  - Specification and implementation of all kinds of black-box tests
  - Platform independent link between modelling and execution
  - Component-based approach
- Standardised at ETSI by TC MTS
  - 15+ years of maintenance work

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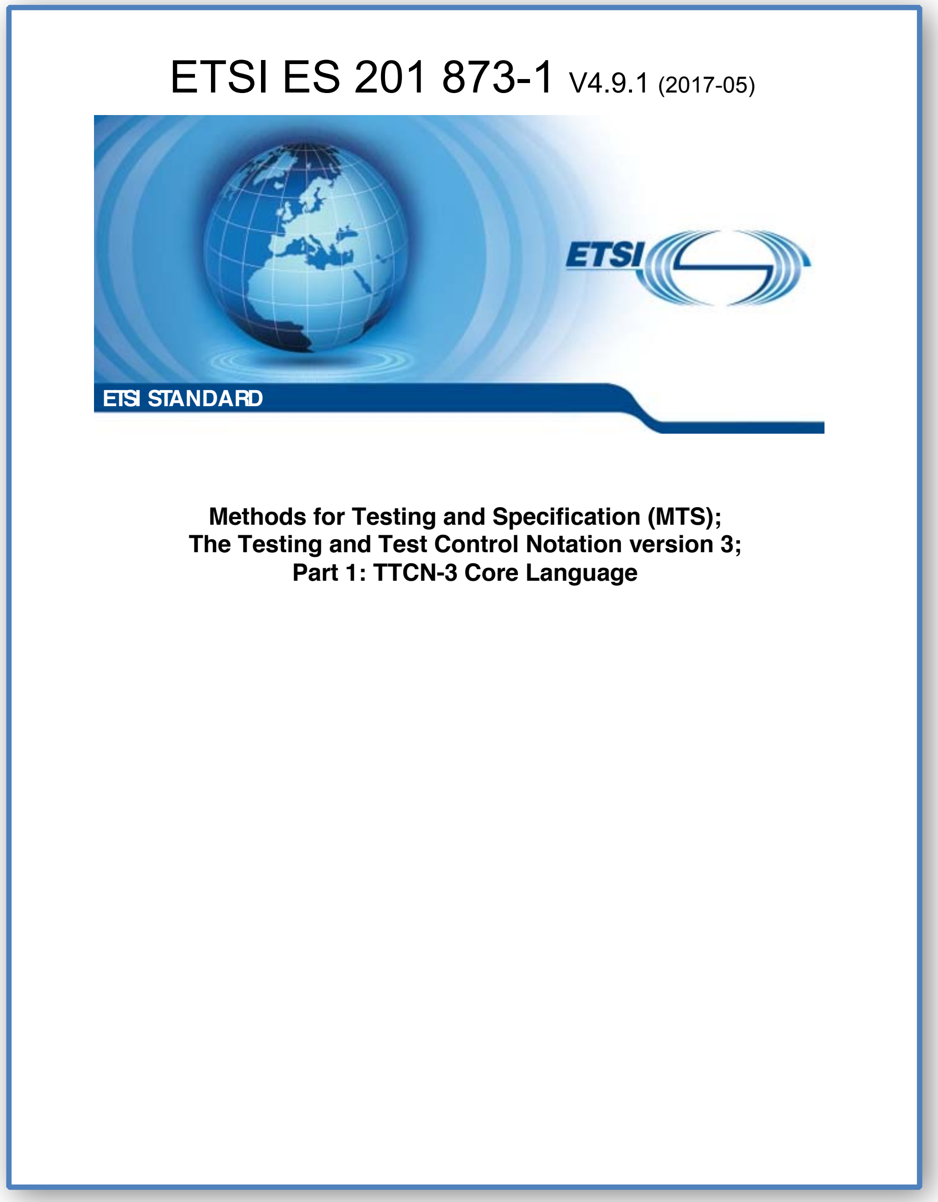

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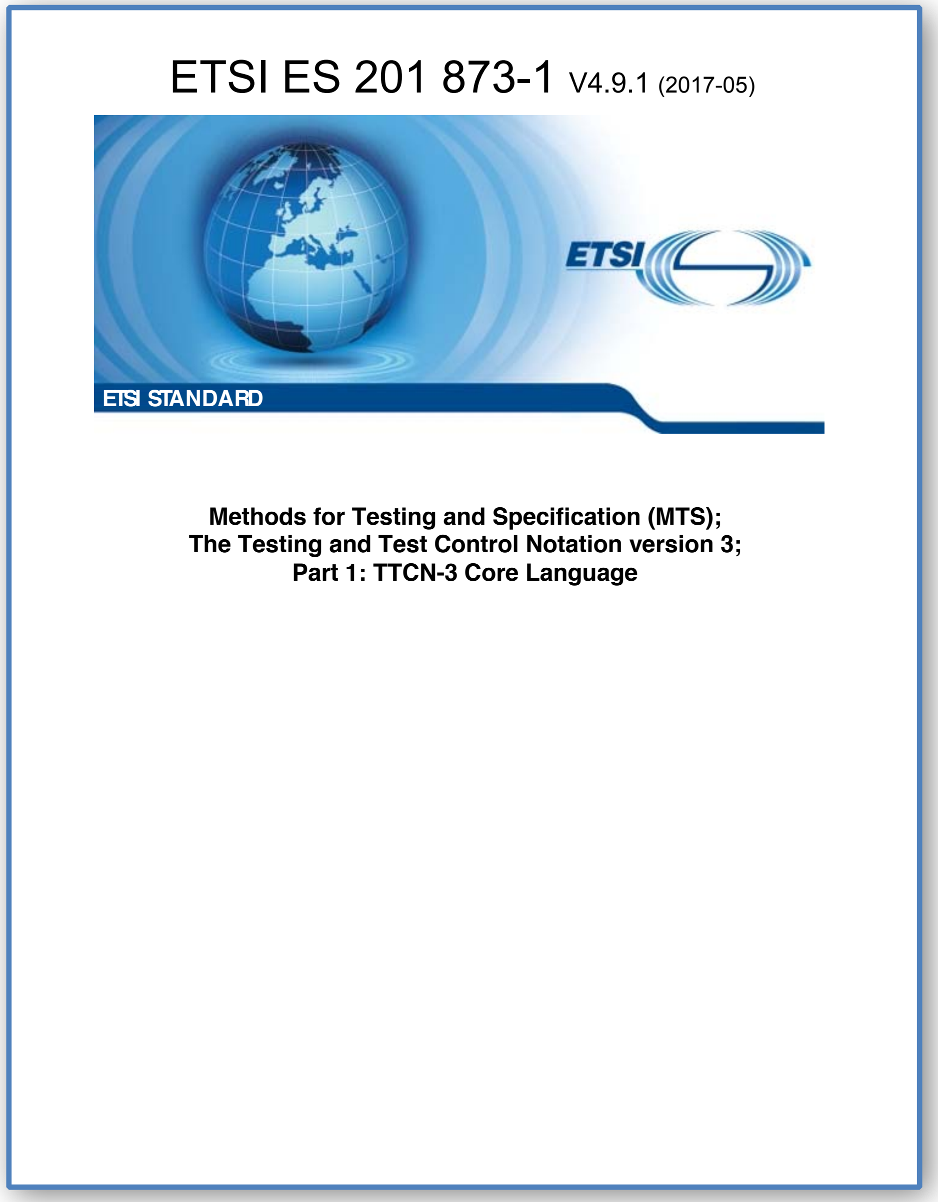
## What is TTCN-3?

- Black-box tests?
  - functional, conformance, interoperability, robustness, load
  - standardisation and certification
- Used in various domains
  - telecommunications
  - automotive
  - railway
  - financial
  - medical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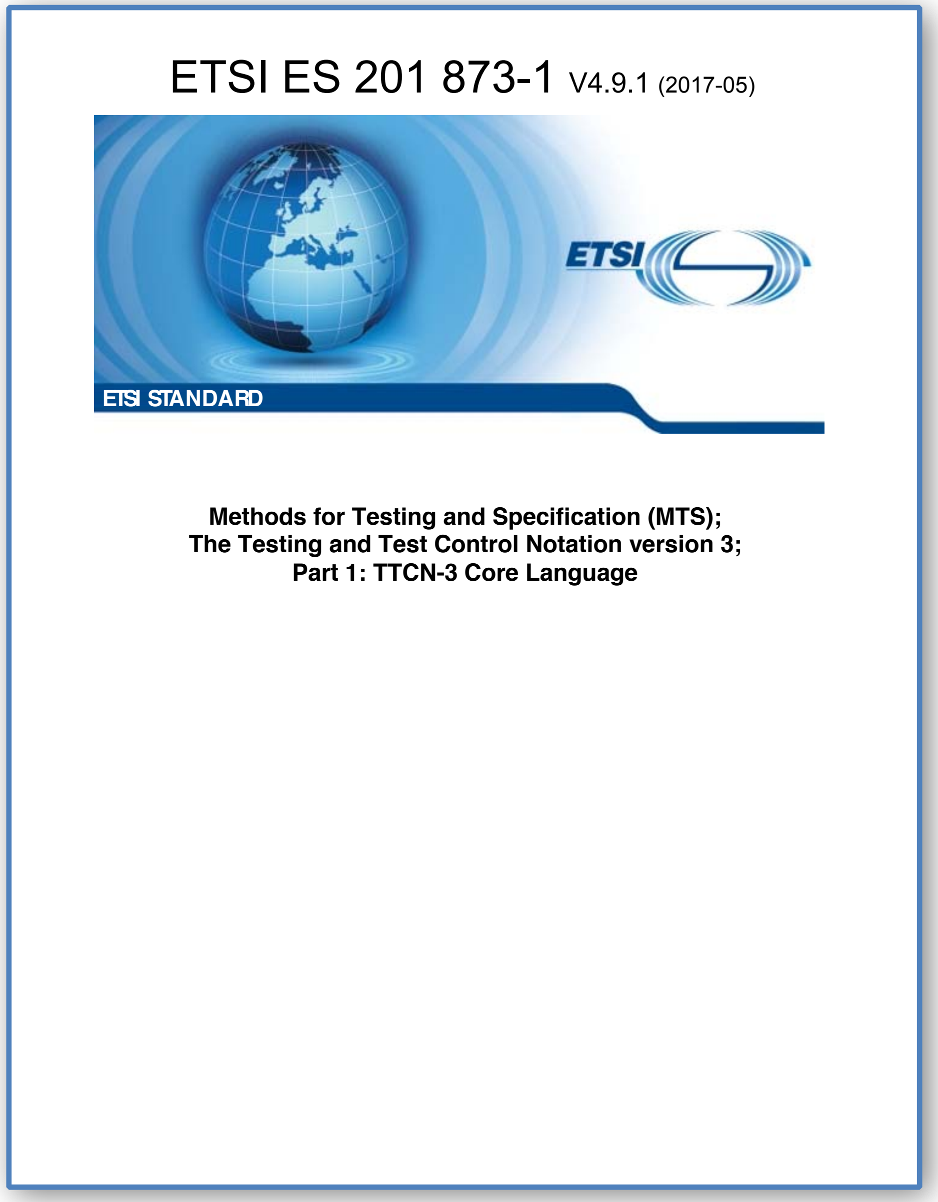
Part 1: TTCN-3 Core Language**

## What is TTCN-3?

- Platform independent?
  - standardised core language
  - standardised interfaces
  - not tied to application or interface
  - not tied to tooling
- Requirements
  - test suite
  - compiler / interpreter
  - adapters and codecs
  - execution environment



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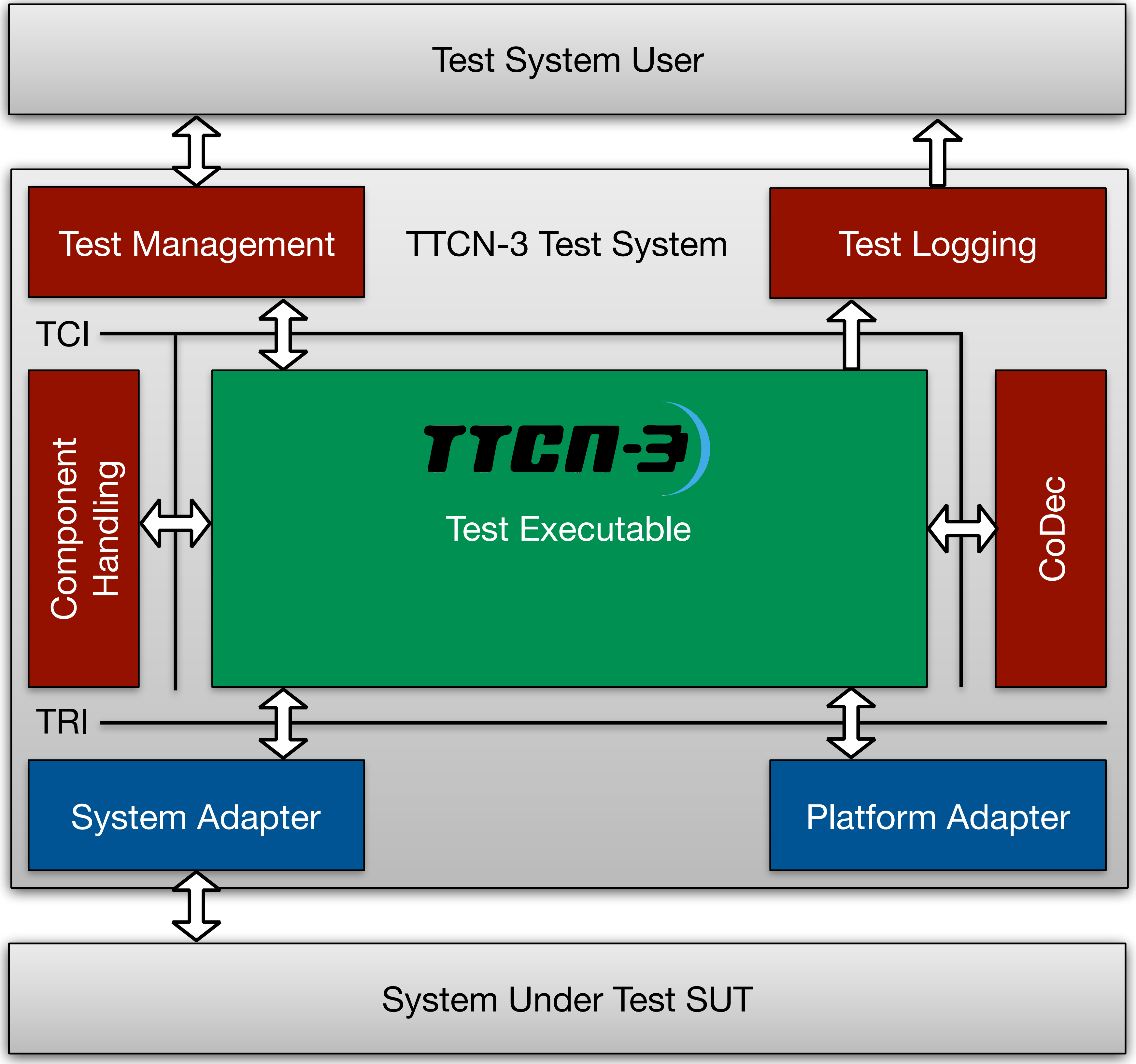
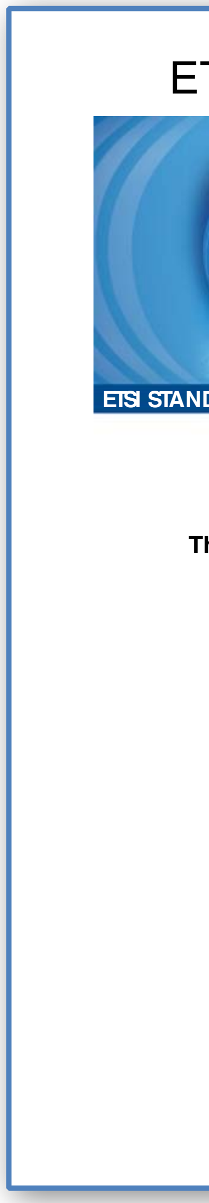
TCI - TTCN-3 Control Interface
TRI - TTCN-3 Runtime Interface



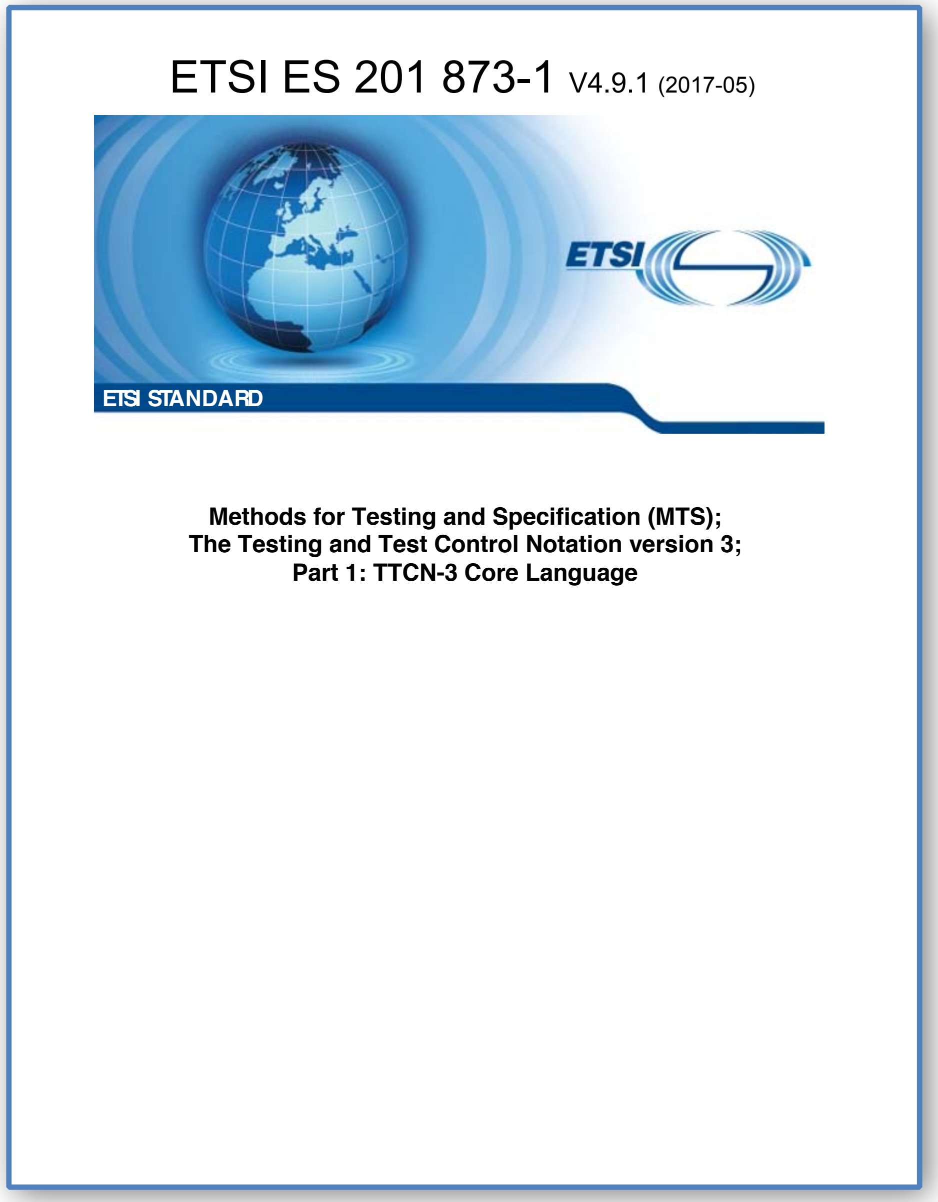


| | | | | |
|---|---|---|---|---|
| Domain | Real-Time and Performance ES 202 782 | Continuous Signals ES 202 786 | | |
| Extension | Advanced Parameterisation ES 202 784 | Advanced Matching ES 203 022 | Static Configurations ES 202 781 | Behaviour Types ES 202 785 |
| Presentation | Tabular ES 201 873-2 | Graphical ES 201 873-3 | Documentation Tags ES 201 873-10 | |
| Core | Core Language ES 201 873-1 | Semantics ES 201 873-4 | | |
| Execution | Control Interfaces ES 201 873-6 | Runtime Interfaces ES 201 873-5 | Extended Runtime Interfaces ES 202 789 | |
| Mappings | ASN.1 ES 201 873-7 | IDL ES 201 873-8 | XML Schema ES 201 873-9 | JSON ES 201 873-11 |

Adapted from Grabowski et al., 2014

## What is TTCN-3?

- Component-based?
  - describe behaviour of test system
  - one or more test components
  - interconnected among each other
  - mapped to unified SUT interface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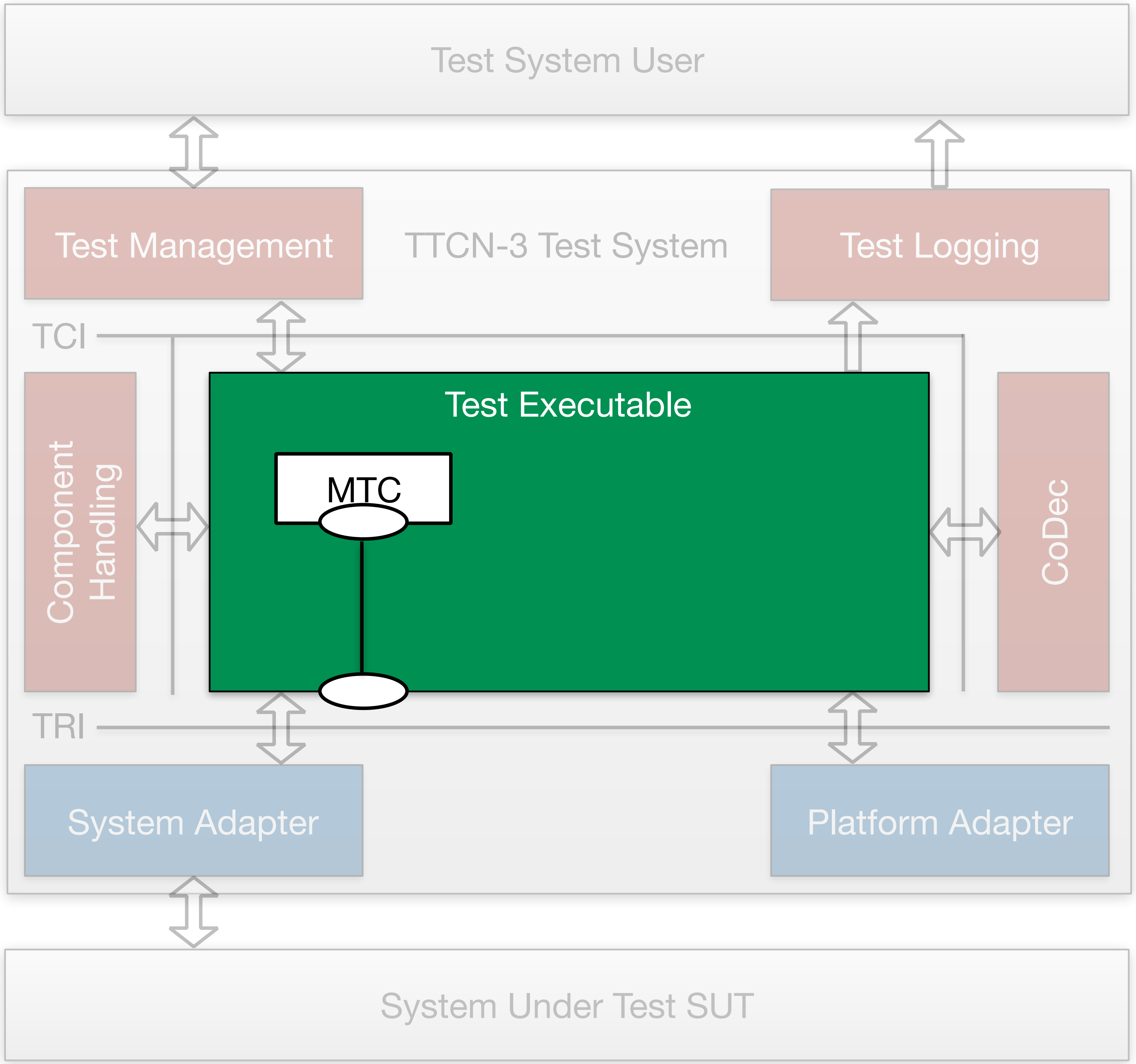
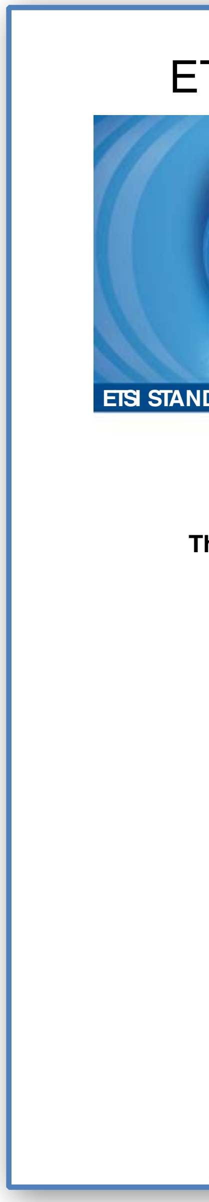
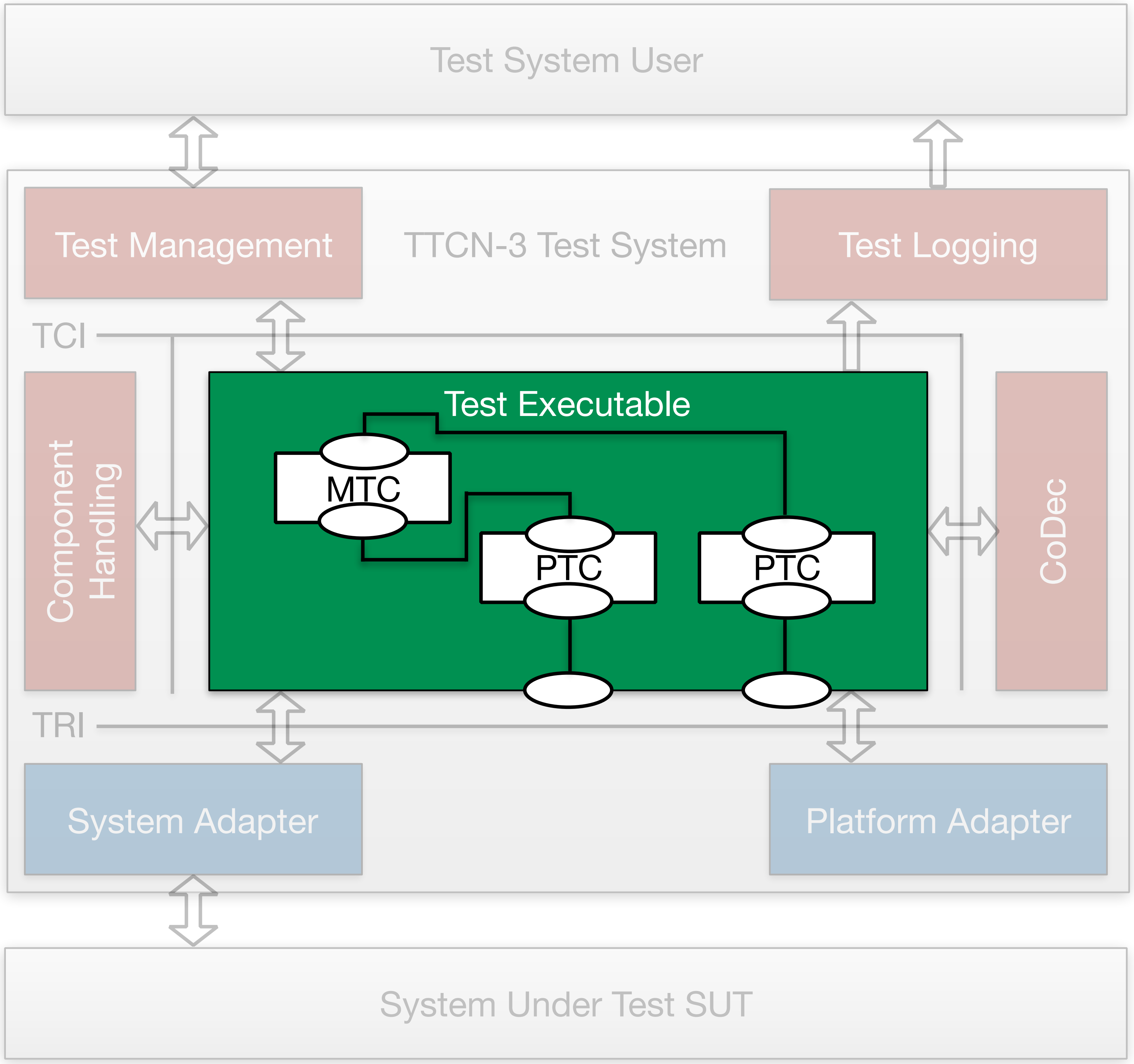
**Methods for Testing and Specification (MTS);**
**The Testing and Test Control Notation version 3;**
**Part 1: TTCN-3 Core Language**

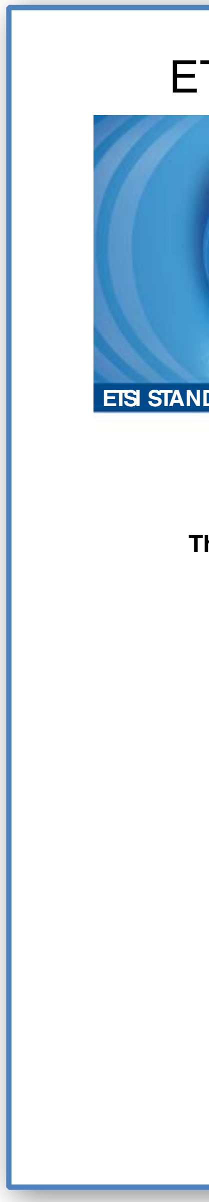
MTC - Main Test Component
PTC - Parallel Test Component





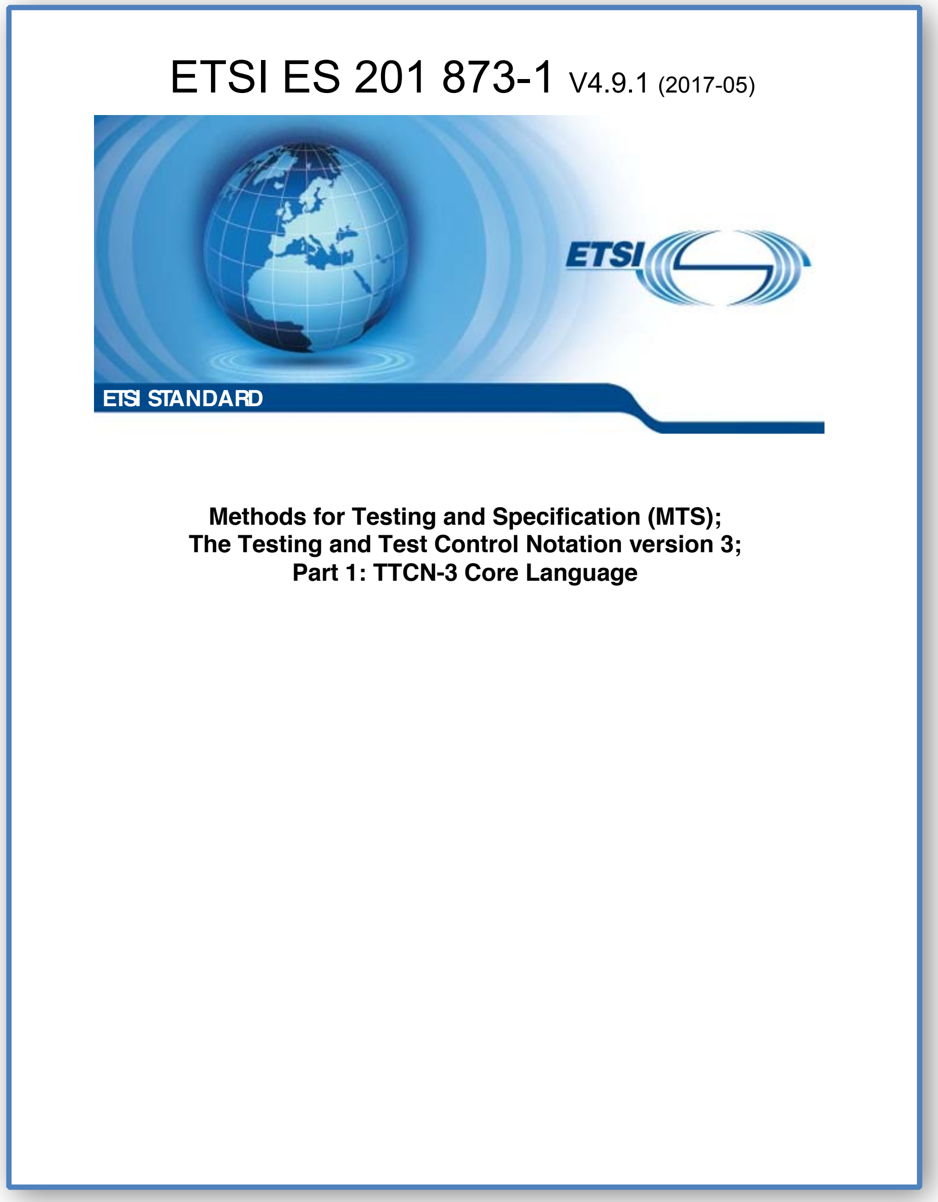
MTC - Main Test Component
PTC - Parallel Test Component





# What is TTCN-3?

- Test suite ingredients
  - Data
    - basic, structured, and special types
    - constants, templates, expressions
  - Configuration
    - components, ports, connections
    - dynamic management
  - Behaviour
    - test cases, functions, altsteps
    - defaults and timers
    - optional test execution control



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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Testing and Test Control Notation version 3;**
**Part 1: TTCN-3 Core Language**

## What is TTCN-3?

```
//enumerated data type
type enumerated MSGKind {question, answer}

//structured data type
type record MSG {
    MSGKind kind,
    charstring content
}


//a question template
template MSG readyQuestion := {
    kind := question,
    content := "Ready?"
}

//a generic question template
//the content shall be provided upon use
template MSG p_Question (charstring c) := {
    kind := question,
    content := c
}

//a generic answer template
template MSG p_Answer (charstring c) := {
    kind := answer,
    content := c
}
```

```
//a generic question template
//any question is fine
template MSG anyQuestion := {
    kind := question,
    content := ?
}

//a generic answer template
//any content is fine
template MSG anyAnswer := {
    kind := answer,
    content := ?
}
```

## What is TTCN-3?

```
//simple port
type port MSGPort message {
    inout MSG
    //may also support transmission of other types
}

//simple component
type component Client {
    timer patience;
    port MSGPort clientPort
    //may also define multiple ports, variables, timers
}


//simple test case
testcase TC_isServiceReady() runs on Client {
   clientPort.send(p_Question("Ready?"));
   alt {
        [] clientPort.receive(p_Answer("Yes!")) {
            setverdict(pass);
        }
        [] clientPort.receive(p_Answer("No!")) {
            setverdict(fail);
        }
   }
}
```

## What is TTCN-3?

```
//simple timed test case
testcase TC_isTimedServiceReady() runs on Client {
    clientPort.send(p_Question("Ready?"));
    patience.start(10.0);
    alt {
        [] clientPort.receive(p_Answer("Yes!")) {
            setverdict(pass);
        }
        [] clientPort.receive(p_Answer("No!")) {
            setverdict(fail);
        }
        [] patience.timeout {
            setverdict(fail);
        }
    }
    patience.stop;
}
```

# What is TTCN-3?

```
//distributed test case
testcase TC_distributed() runs on Client
  system Service {
    //create components
    var Client client1 := Client.create;
    var Client client2 := Client.create;
    //map / connect components
    map(system:servicePort, client1:clientPort);
    map(system:servicePort, client2:clientPort);

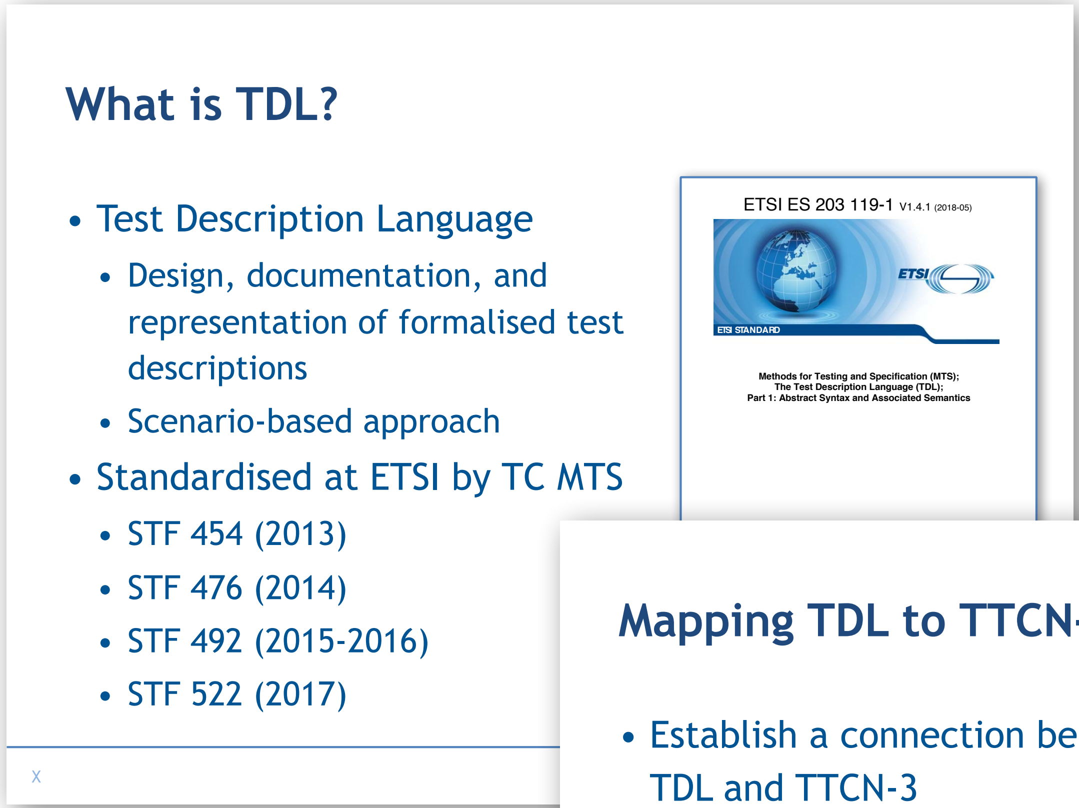
    //start initiate behaviour of components
    client1.start(f_isReady());
    client2.start(f_isReady());

    //wait for components to complete their execution
    all component.done;
}
```

```
//handle timeouts and incoming questions
 altstep impatientYesMan() runs on Client {
     [] clientPort.receive(p_Question(?)) {
         clientPort.send(p_Answer("Yes!"))
         repeat;
     }
     [] patience.timeout {
         setverdict(fail);
     }
 }

 //reusable behaviour
 //can be executed multiple times
 function f_isReady() runs on Client {
     clientPort.send(p_Question("Ready?"));
     patience.start(10.0);
     activate(impatientYesMan());
     alt {
         [] clientPort.receive(p_Answer("Yes!")) {
             setverdict(pass);
         }
         [] clientPort.receive(p_Answer("No!")) {
             setverdict(fail);
         }
     }
}
```

# Overview



### What is TDL?

- Test Description Language
  - Design, documentation, and representation of formalised test descriptions
  - Scenario-based approach
- Standardised at ETSI by TC MTS
  - STF 454 (2013)
  - STF 476 (2014)
  - STF 492 (2015-2016)
  - STF 522 (2017)

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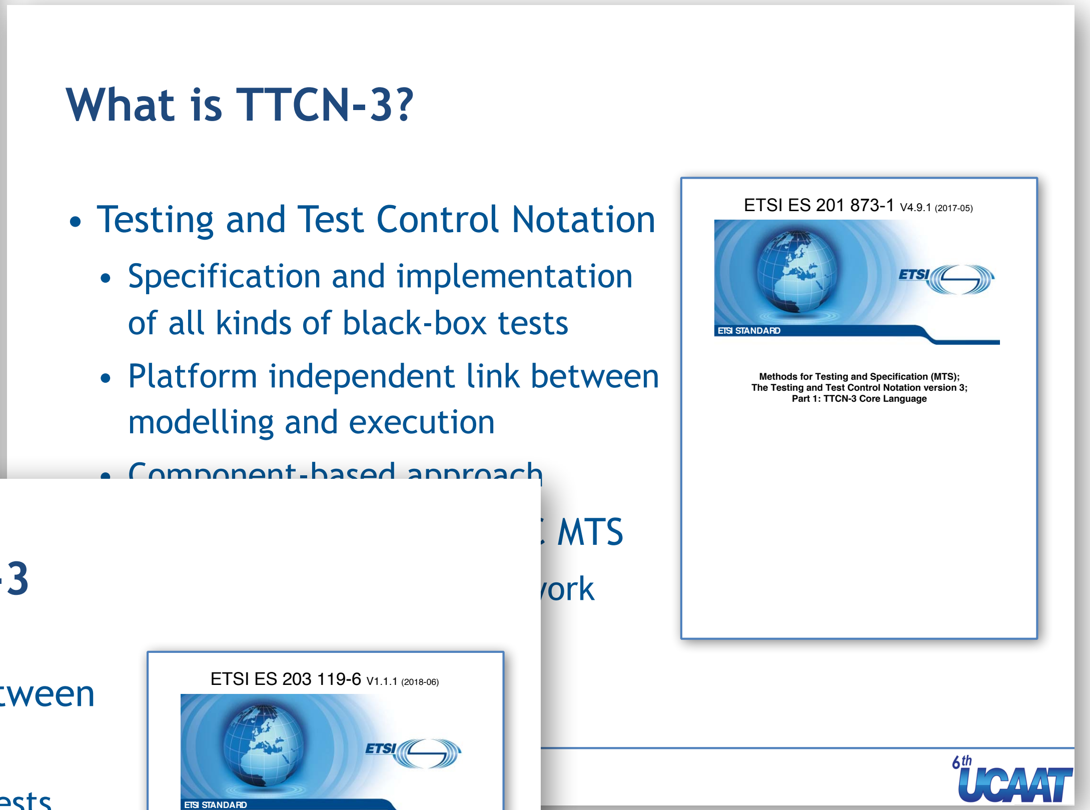
ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 1: Abstract Syntax and Associated Semantics

x



### What is TTCN-3?

- Testing and Test Control Notation
  - Specification and implementation of all kinds of black-box tests
  - Platform independent link between modelling and execution
  - Component-based approach

MTS

ork

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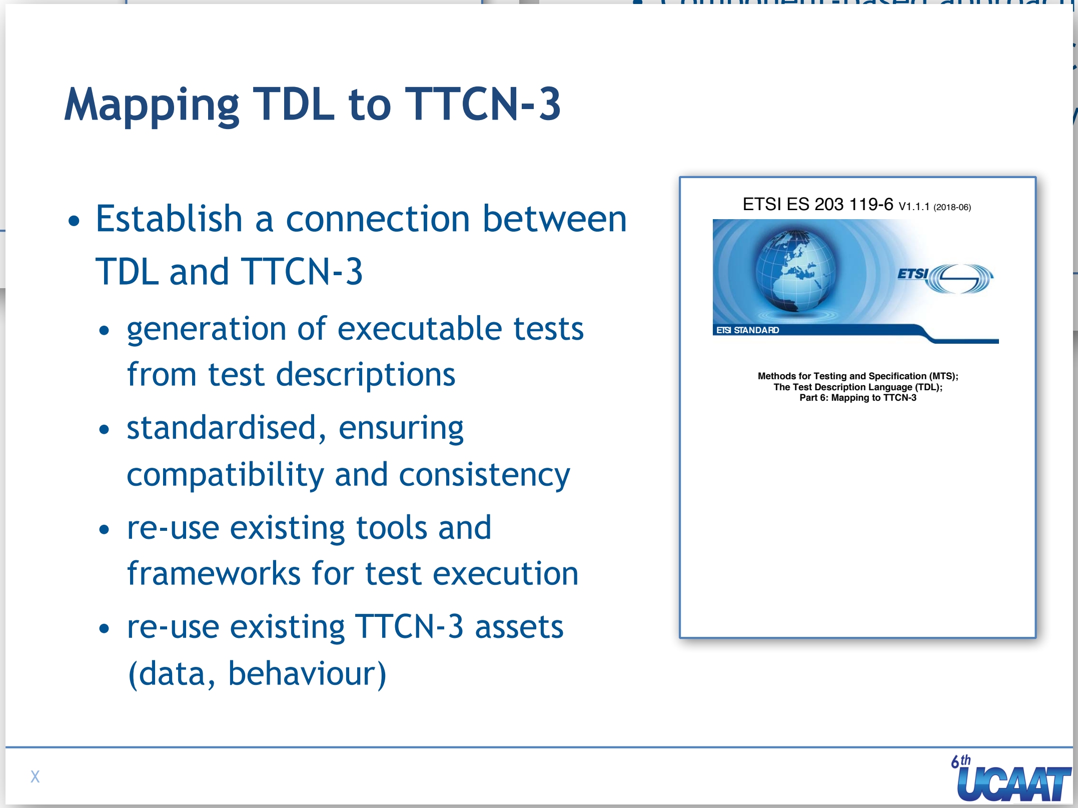
ETSI STANDARD

Methods for Testing and Specification (MTS);
The Testing and Test Control Notation version 3;
Part 1: TTCN-3 Core Language

6th UCAAT



### Mapping TDL to TTCN-3

- Establish a connection between TDL and TTCN-3
  - generation of executable tests from test descriptions
  - standardised, ensuring compatibility and consistency
  - re-use existing tools and frameworks for test execution
  - re-use existing TTCN-3 assets (data, behaviour)

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

x

6th UCAAT

# Mapping TDL to TTCN-3

- Establish a connection between TDL and TTCN-3
  - generation of executable tests from test descriptions
  - standardised, ensuring compatibility and consistency
  - re-use existing tools and frameworks for test execution
  - re-use existing TTCN-3 assets (data, behaviour)

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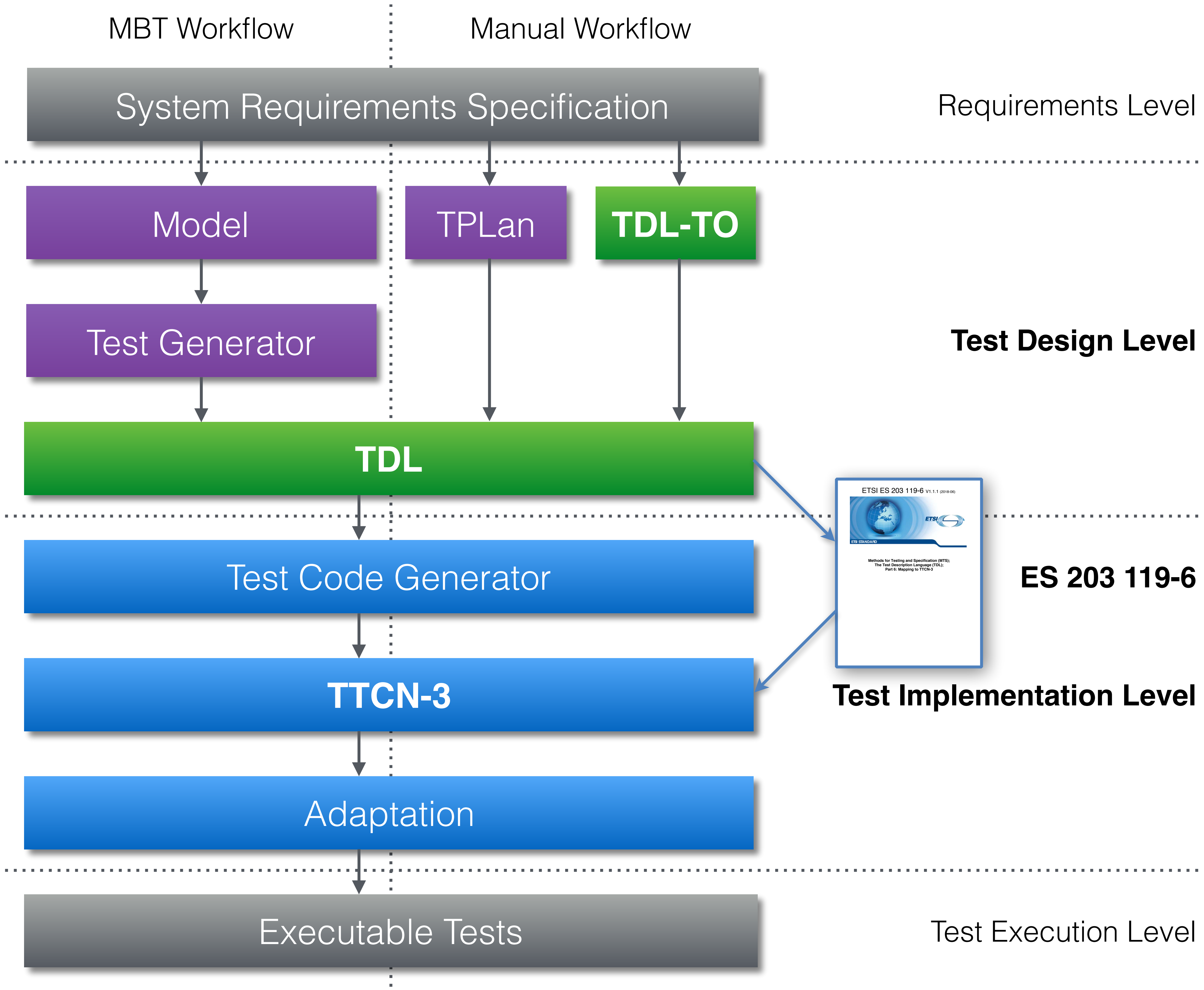
ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3


MBT Workflow
Manual Workflow
System Requirements Specification
Requirements Level
Model
TPLan
TDL-TO
Test Generator
Test Design Level
TDL
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ETSI
ETSI STANDARD
Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3
ES 203 119-6
Test Code Generator
TTCN-3
Test Implementation Level
Adaptation
Executable Tests
Test Execution Level

## Mapping TDL to TTCN-3

- Challenges
  - different levels of abstraction
  - different perspectives
  - different assumptions
    - behaviour
    - configurations
    - data
    - time

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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3

- Levels of abstraction
  - TTCN-3
    - low - close to implementation
    - sufficient for automated execution
    - still abstracts away some details
  - TDL
    - high - test purposes (TO-extension)
    - medium - test design and description
    - low - some implementation details
    - focus on relevant parts at every level

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Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

## Mapping TDL to TTCN-3

- Perspectives
  - TTCN-3
    - test-system centric (test system view)
    - test components
    - unified SUT interface (ports)
  - TDL
    - system centric (global view)
    - tester and SUT components (roles)
    - describes entire scenario

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**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3

- Assumptions: Data
  - TTCN-3
    - comprehensive type system
    - powerful template mechanism
    - extensive matching operators
  - TDL
    - mappable symbolic elements
    - types and instances
    - wildcards
    - limited direct data manipulation
    - nested arguments for data use

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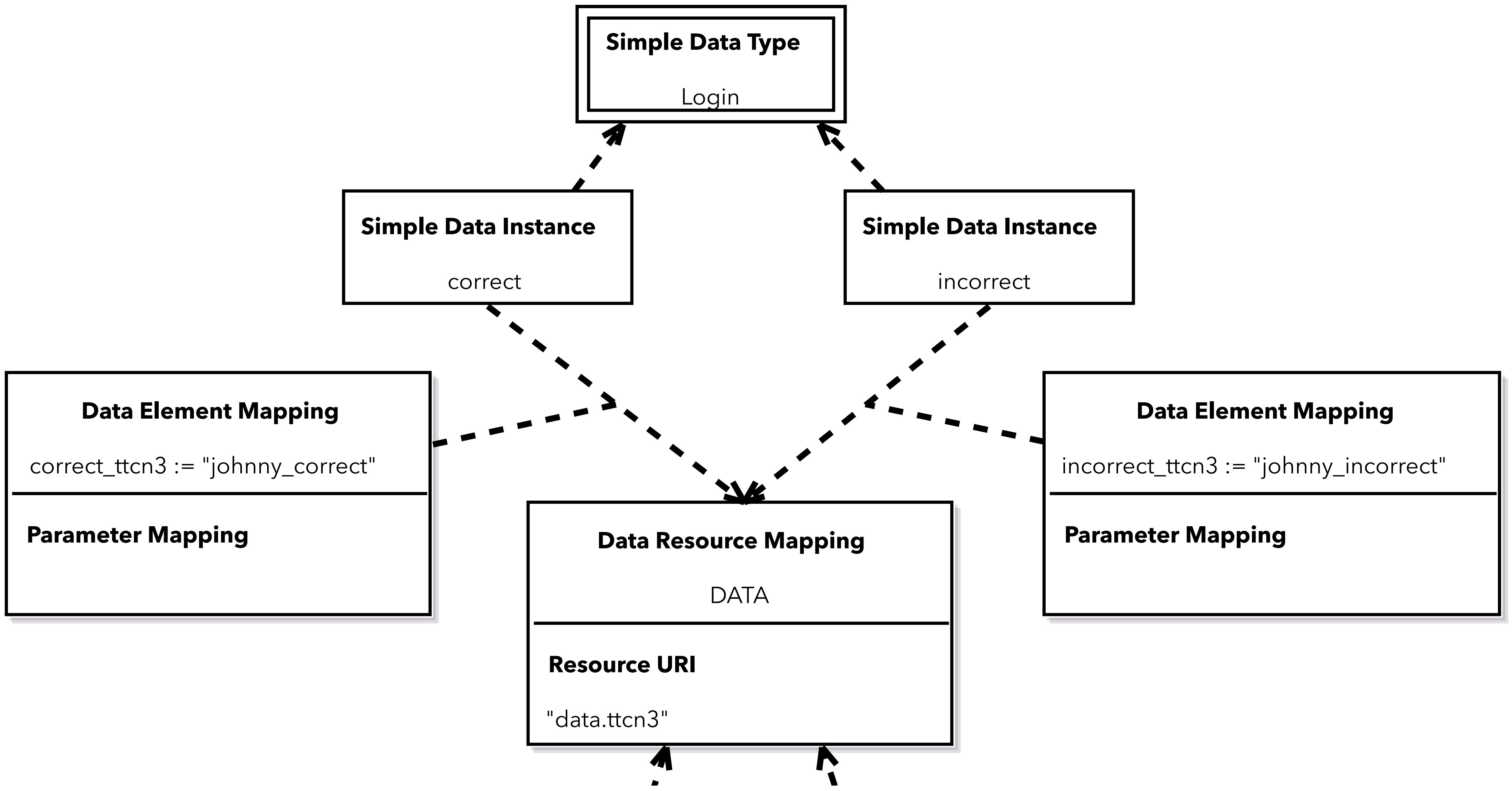
Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3


Simple Data Type
Login
Simple Data Instance
correct
Simple Data Instance
incorrect
Data Element Mapping
correct_ttcn3 := "johnny_correct"
Parameter Mapping
Data Resource Mapping
DATA
Resource URI
"data.ttcn3"
Data Element Mapping
incorrect_ttcn3 := "johnny_incorrect"
Parameter Mapping

## Mapping TDL to TTCN-3

- Mapping: Data Definition
  - data mappings within TDL required
    - also for all members
    - substituted by respective targets
  - basic generation in case absent
    - charstrings, records, templates
    - functions for functions and actions
  - annotations override assumptions
    - also for variables and parameters

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ETSI STANDARD

**Methods for Testing and Specification (MTS); The Test Description Language (TDL); Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3: Data definition

```
//data types
Type SESSIONS (id1 of type Integer, id2 of type Integer);
Type MSG (ses of type SESSIONS, content of type String);

//data instances
SESSIONS s1(id1 = 1, id2 = 2);
SESSIONS s2(id1 = 11, id2 = 22);
MSG msg1(ses = s1, content = m1);

//value data instances
SESSIONS c_s1(id1 = 1, id2 = 2) with {VALUE;};
MSG c1(ses = s1, content = c1) with {VALUE;};

Component Type ct having {
    //variables
    variable v1 of type MSG with {VALUE;};
    variable v2 of type MSG;
    gate g of type gt;
}
```

```
//data types
type record SESSIONS {
    integer id1,
    integer id2
}
type record MSG {
    SESSIONS ses,
    charstring content
}

//templates
template SESSIONS s1 := {id1:=1, id2:=2}
template SESSIONS s2 := {id1:=11, id2:=22}
template MSG msg1 := {ses := s1, content := "m1"}

//value -> constant
const SESSIONS c_s1 := {id1:=1, id2:=2}
const MSG c1 := {ses := c_s1, content := "c1"}

type component ct {
    //variables
    var MSG v1;
    var template MSG v2;
    port gt g;
}
```

## Mapping TDL to TTCN-3

- Mapping: Data Use
  - treatment as values or templates
    - temporary templates
    - using valueOf
  - modification for arguments
    - inline for first level
    - iterative for nested arguments
  - special values
    - AnyValue -> ?
    - AnyValueOrOmit -> * (optional), ?
    - OmitValue -> omit

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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3: Data use

```
Test Description td uses configuration tc {
    //one level arguments
    tester.g sends msg1(ses = s2) to sut.g;

    //nested arguments
    tester.g sends msg1(ses = s1(id1 = 111)) to sut.g;

    //nested arguments with value
    tester.g sends msg1(ses = c_s1(id1 = 111)) to sut.g;
}
```

```
function td_tester() runs on ct {
    //one level arguments
    g.send(modifies msg1 := {ses := s2});

    //nested arguments
    template SESSIONS t_s1 modifies s1 := {id1:=111};
    g.send(modifies msg1 := {ses := t_s1});

    //nested arguments with constants
    template SESSIONS t_c_s1 := c_s1;
    template SESSIONS t_c_s1_m modifies t_c_s1 :=
        {id1:=111};
    g.send(modifies msg1 := {ses := t_c_s1_m});
}
```

## Mapping TDL to TTCN-3

- Assumptions: Configurations
  - TTCN-3
    - dynamic instantiation / management
    - MTC, PTCs, system interface
    - mapping vs connecting ports
    - connection and mapping restrictions
  - TDL
    - static configuration defined upfront
    - holistic view, multiple SUTs

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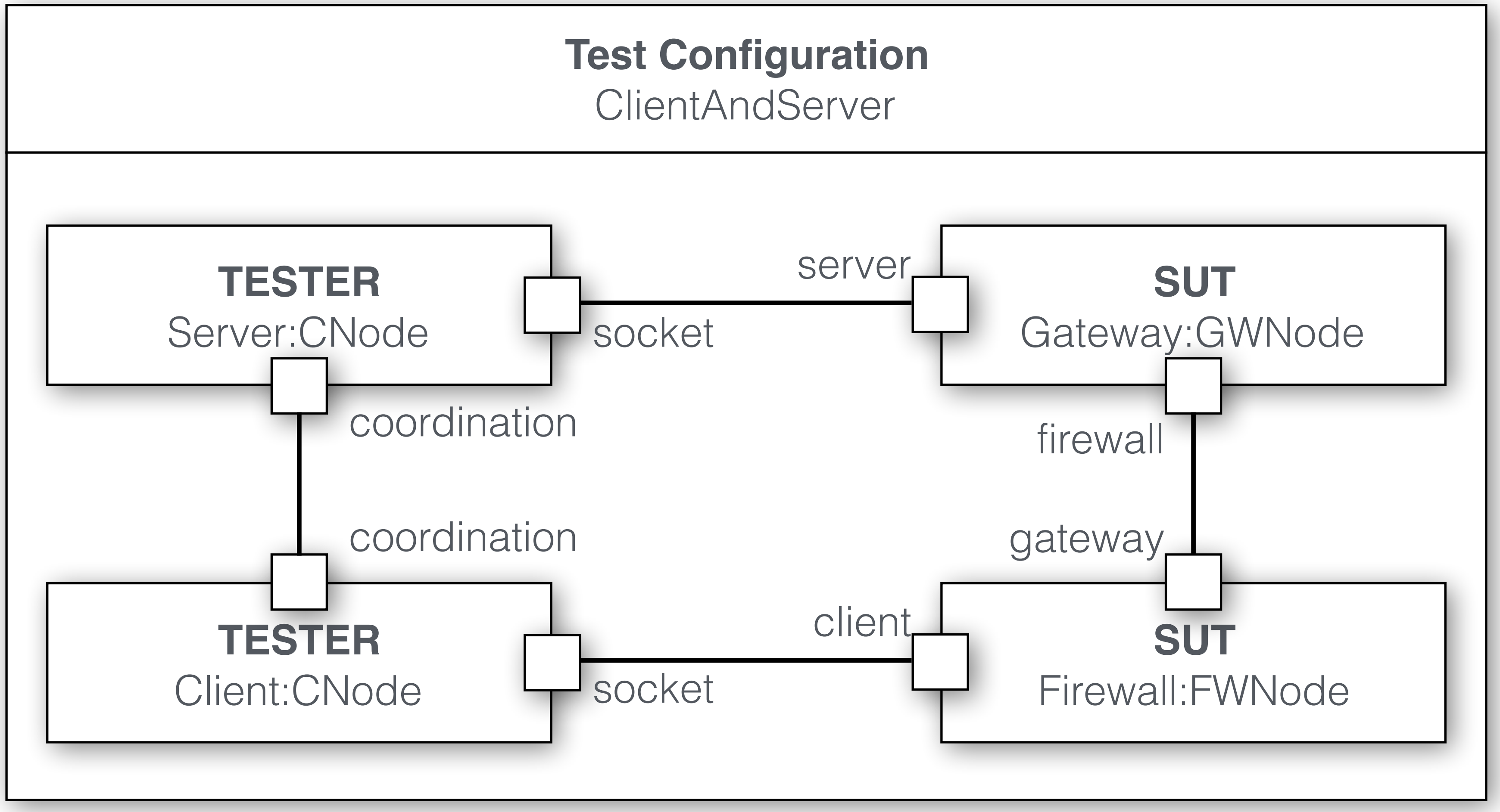
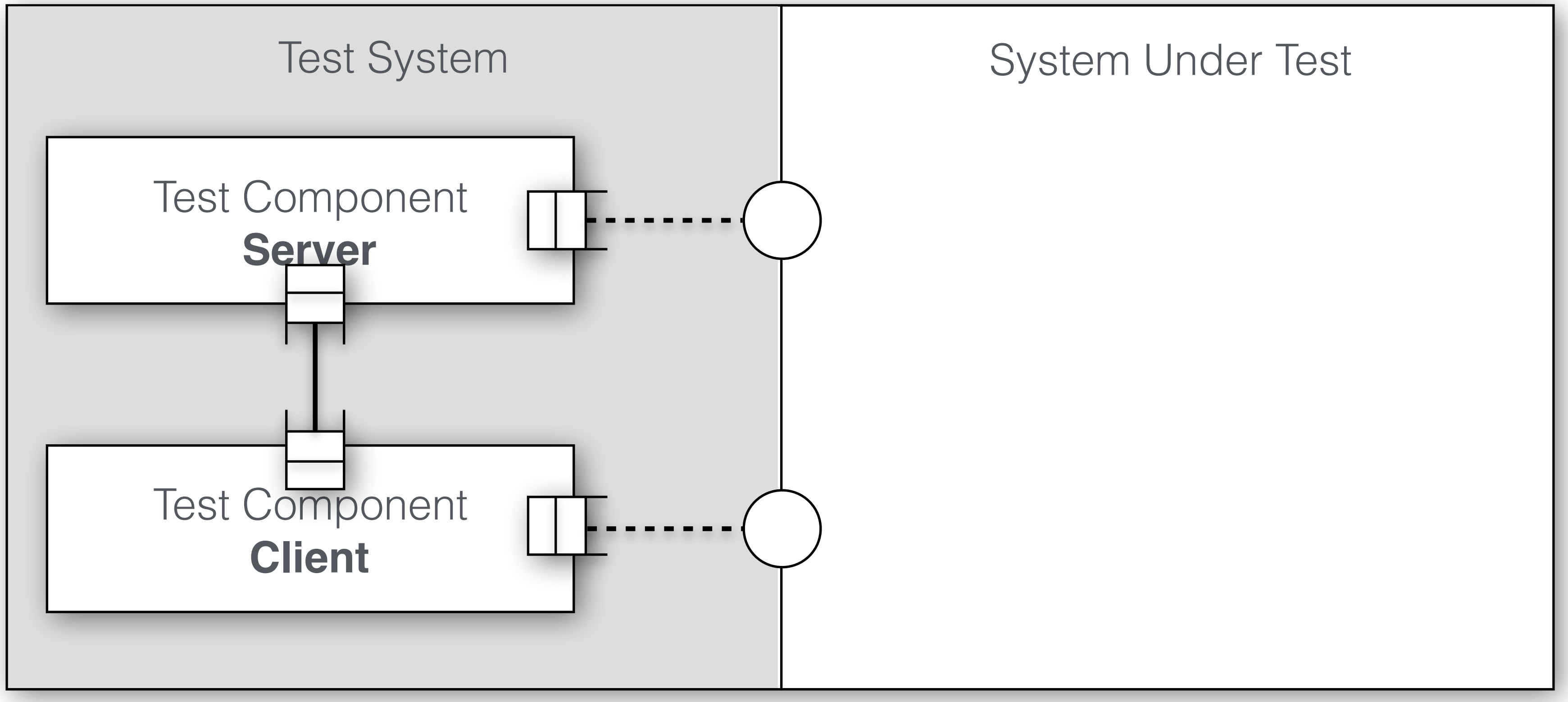
Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3



Test Configuration
ClientAndServer
TESTER
Server:CNode
socket
server
SUT
Gateway:GWNode
coordination
firewall
coordination
gateway
TESTER
Client:CNode
socket
client
SUT
Firewall:FWNode



Test System
System Under Test
Test Component
Server
Test Component
Client

## Mapping TDL to TTCN-3

- Mapping: Configurations
  - port types for each gate type
  - infer unified system interface
  - types for MTC, system components
  - types for tester components
  - creating components
  - map and connect ports
  - respect restrictions in TTCN-3
  - some ports may need to be cloned

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ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3: Configurations

```
Gate Type defaultGT accepts
    ACK, PDU, PDCCH, C_RNTI, CONFIGURATION ;

Component Type defaultCT having {
    gate g of type defaultGT;
}

Test Configuration defaultTC {
    create Tester SS of type defaultCT;
    create SUT UE of type defaultCT ;
    connect UE.g to SS.g ;
}
```

```
type port defaultGT_to_map message {
  //this is a port type for SUT-Tester connections
  inout charstring, PDCCH /* ACK, PDU, C_RNTI, CONFIGURATION ; */
}

type port defaultGT_to_connect message {
  //this is a port type for Tester-Tester connections
  inout charstring, PDCCH /* ACK, PDU, C_RNTI, CONFIGURATION ; */
}

type component MTC_CT {
  //component type for MTC
  //variable for the PTC(s) --TESTER component(s) in TDL
  var defaultCT TESTER_SS;
}

type component defaultCT {
  port defaultGT_to_map g_to_map;
  port defaultGT_to_connect g_to_connect;
}

function defaultTC() runs on MTC_CT {
  // Test Configuration defaultTC, mappings, connections
  TESTER_SS := defaultCT.create;
  map (TESTER_SS:g_to_map,system:g_to_map);
}
```

# Mapping TDL to TTCN-3

- Assumptions: Behaviour
  - TTCN-3
    - test system view
    - independent concurrent execution
    - explicit synchronisation
    - strictly local behaviours
  - TDL
    - global view
    - global or local ordering
    - implicit or explicit synchronisation
    - global combined behaviours

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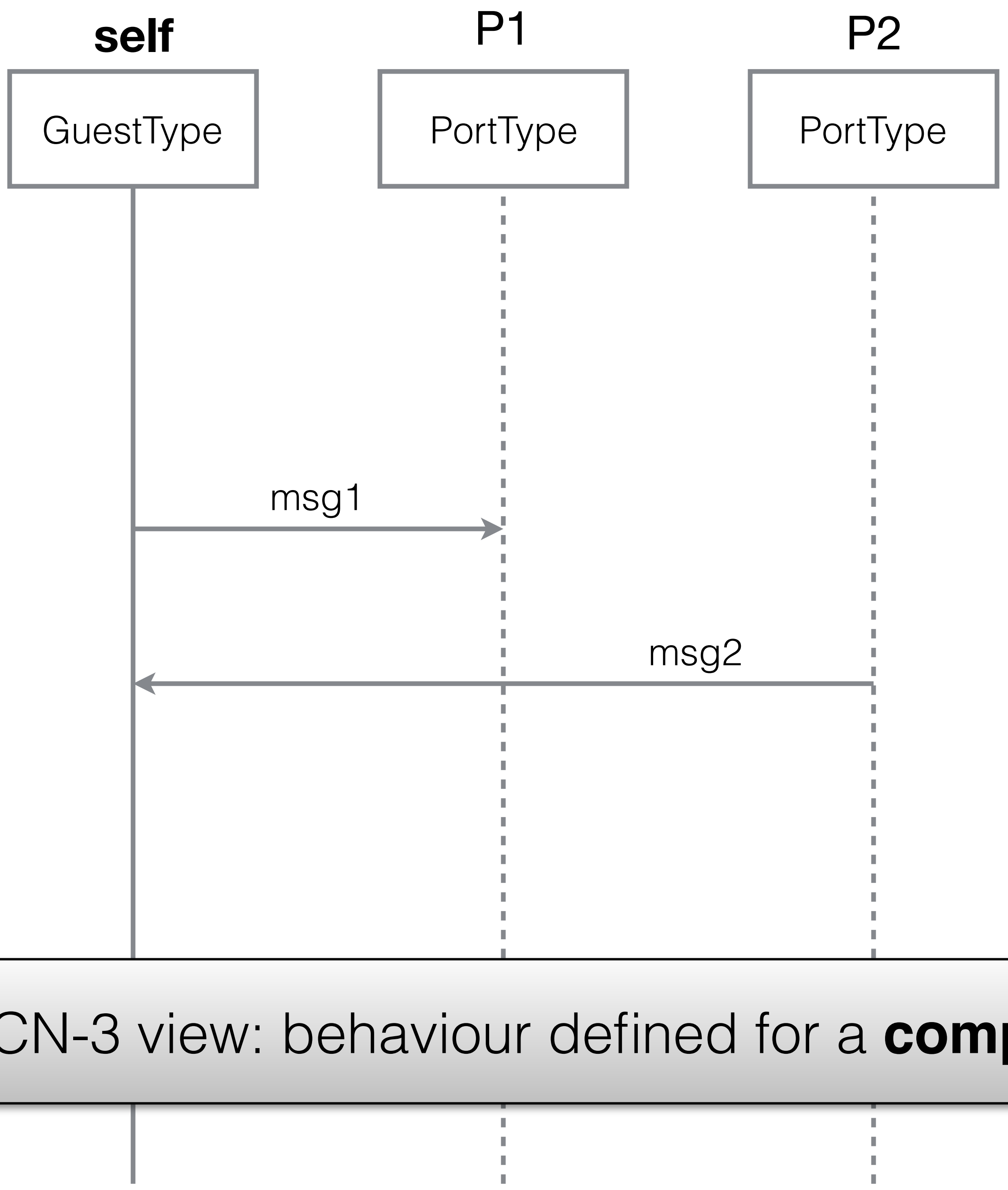
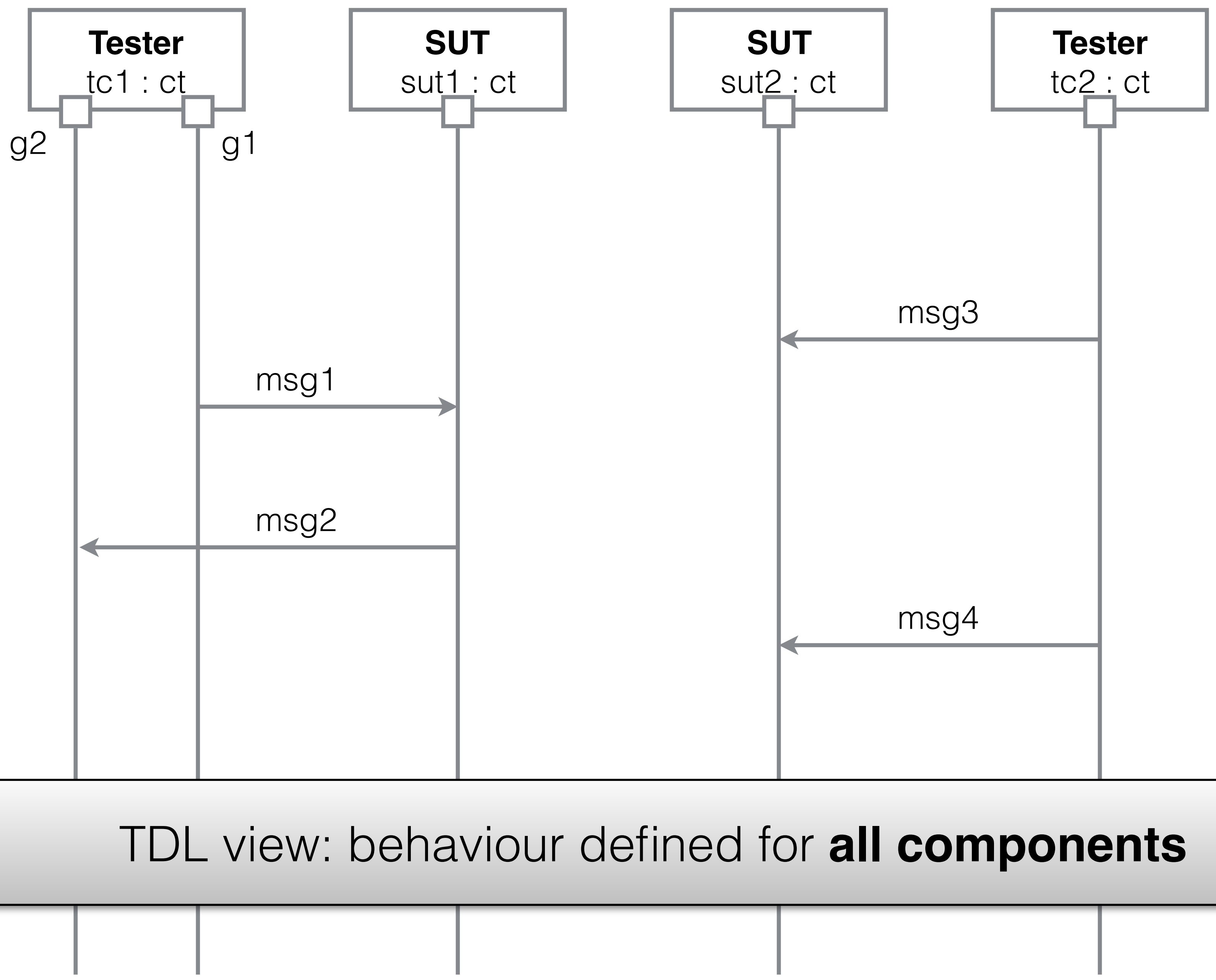
**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

## Mapping TDL to TTCN-3: Views



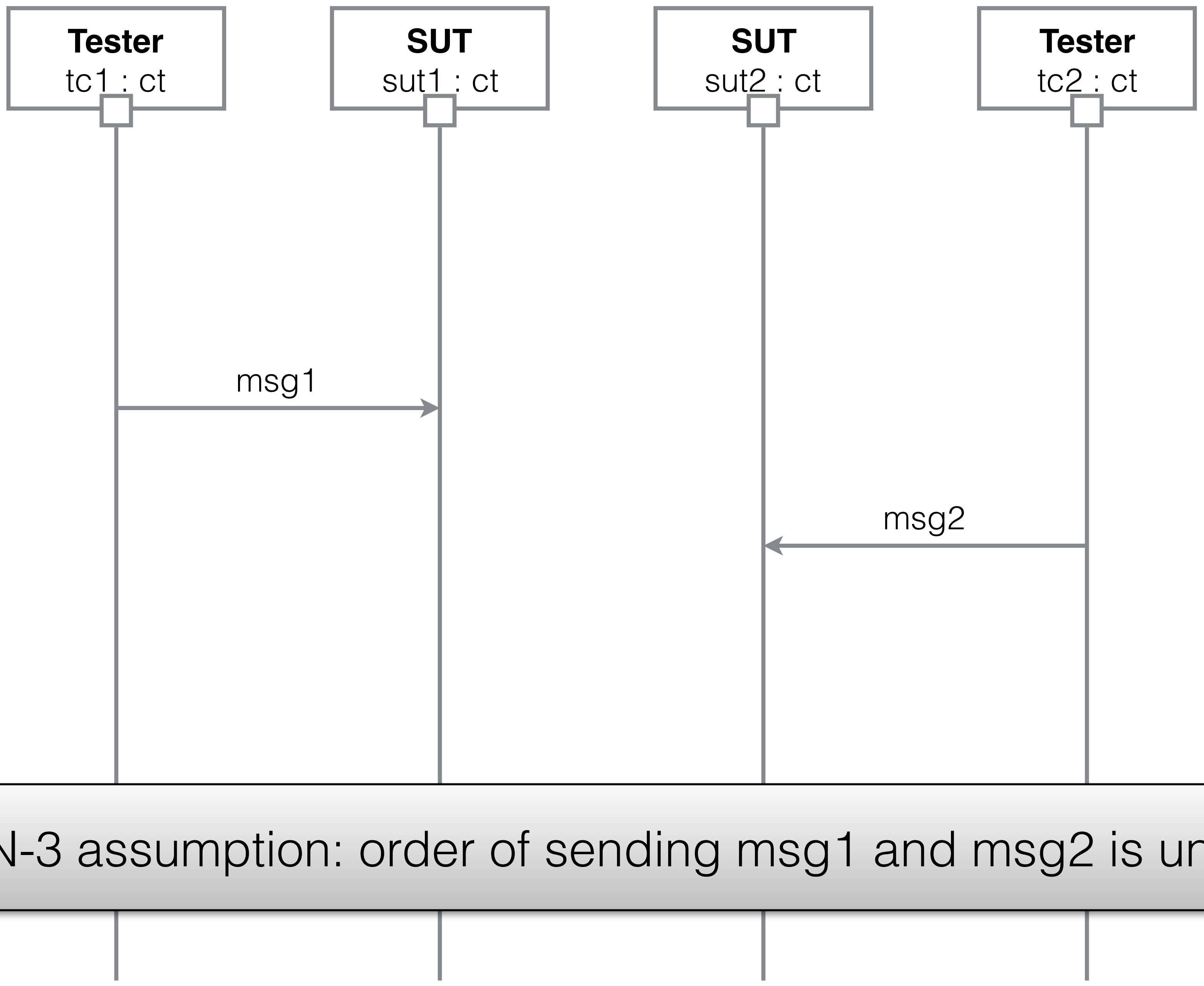
TTCN-3 view: behaviour defined for a **component and** its **ports**

## Mapping TDL to TTCN-3: Views



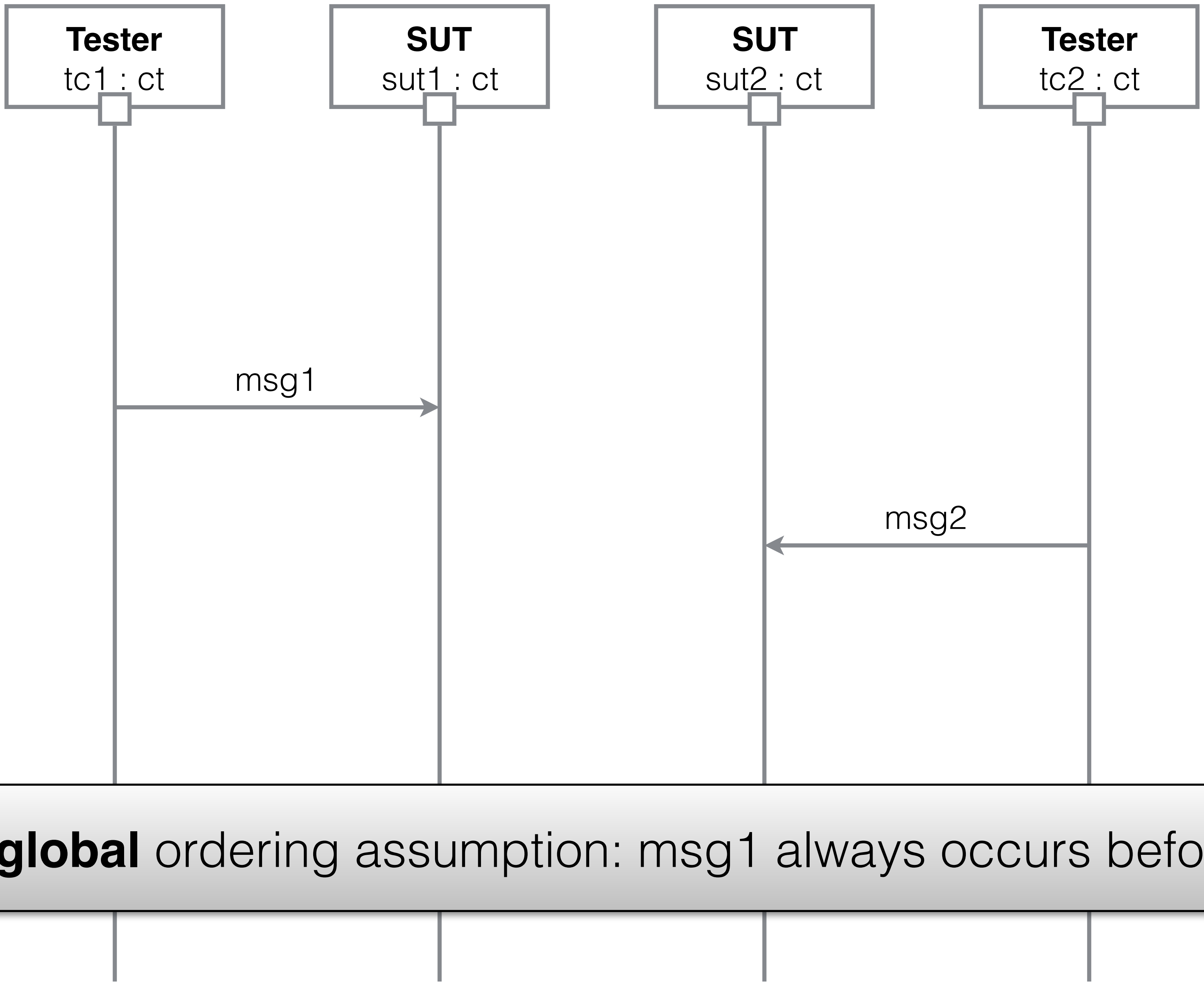
TDL view: behaviour defined for **all components**

# Mapping TDL to TTCN-3: Ordering



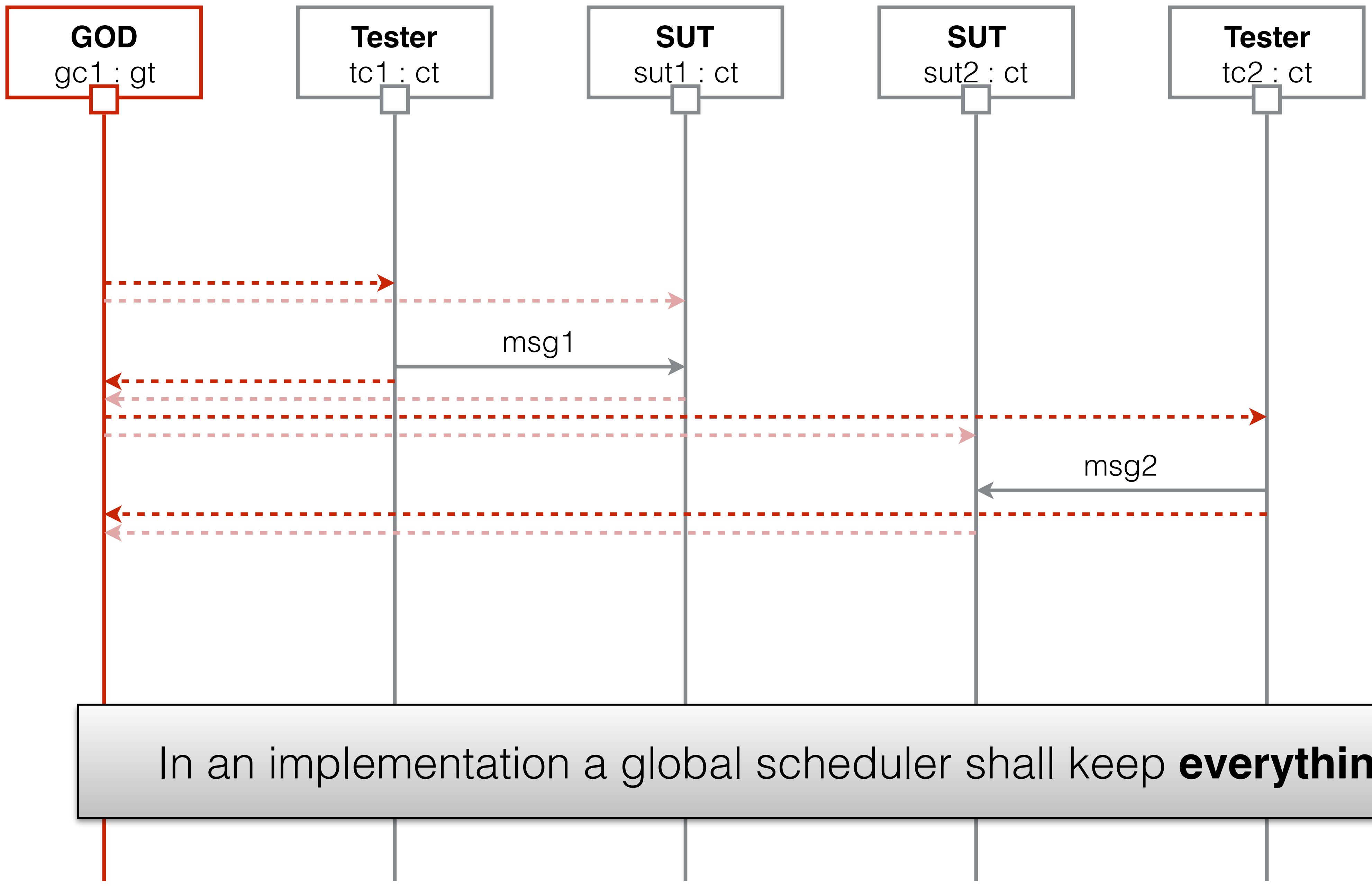
TTCN-3 assumption: order of sending msg1 and msg2 is undefined

# Mapping TDL to TTCN-3: Ordering



TDL **global** ordering assumption: msg1 always occurs before msg2

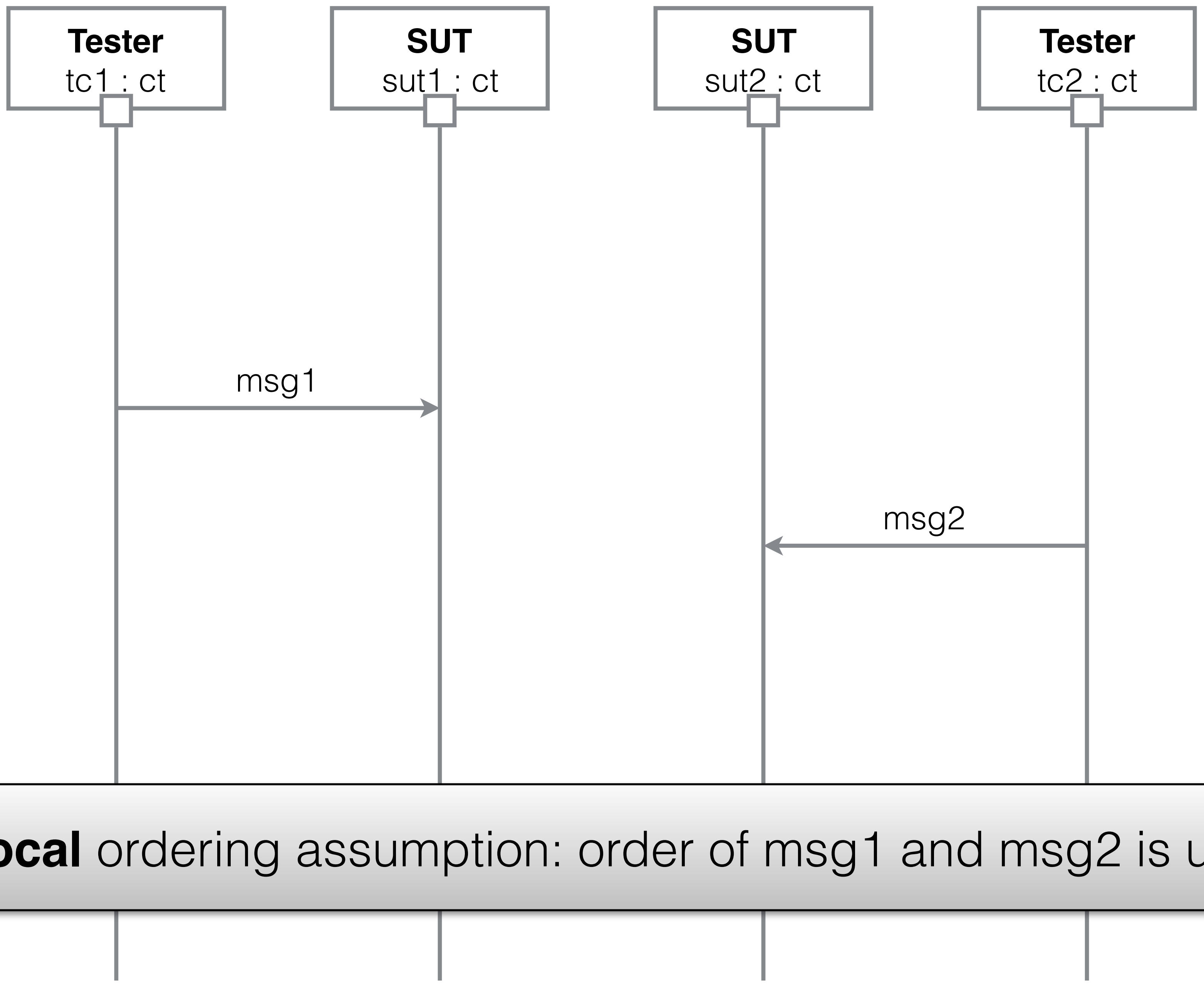
# Mapping TDL to TTCN-3: Ordering



In an implementation a global scheduler shall keep **everything** in order

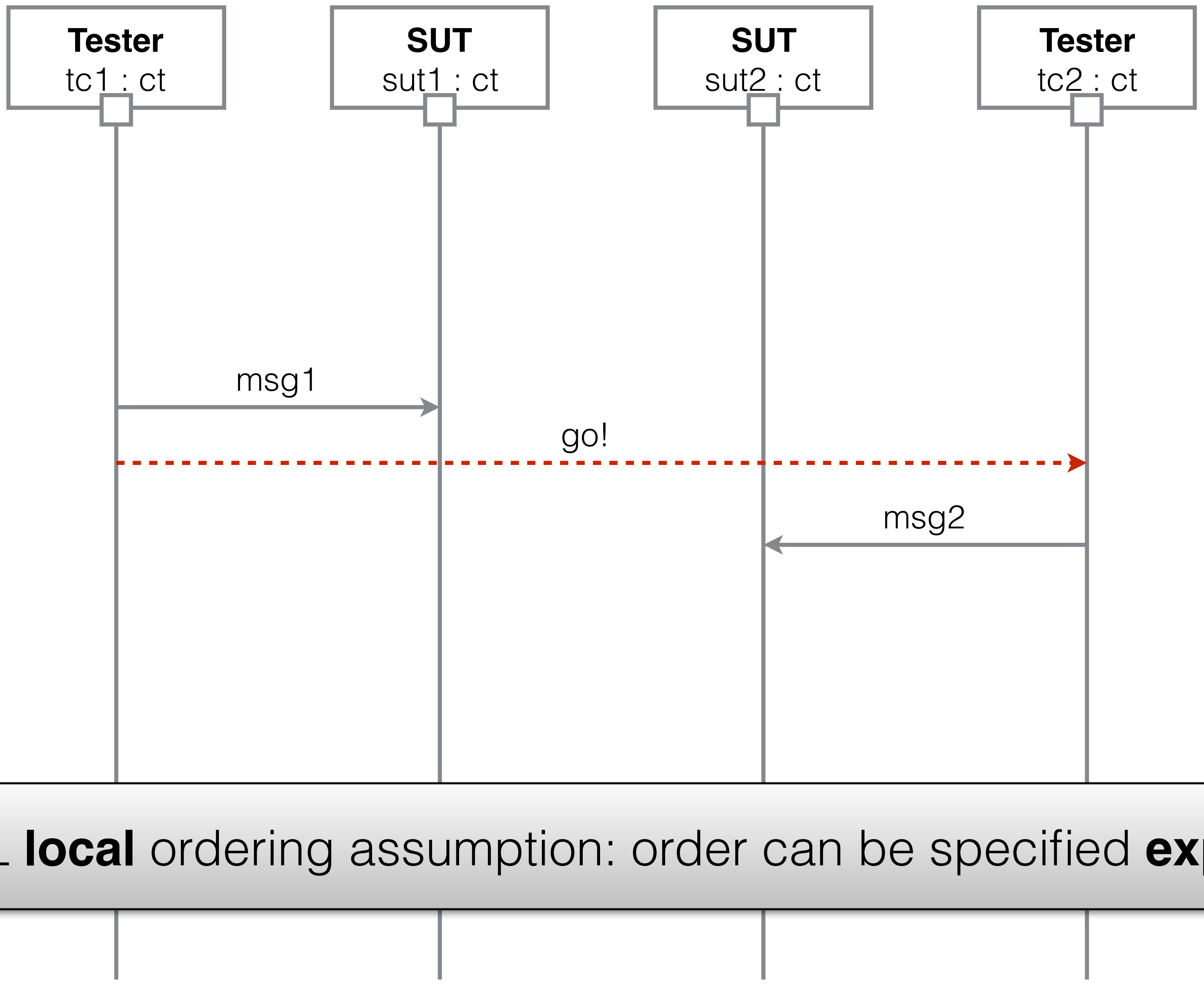
GOD*: Global Order Dispatcher

# Mapping TDL to TTCN-3: Ordering



TDL **local** ordering assumption: order of msg1 and msg2 is undefined

# Mapping TDL to TTCN-3: Ordering



TDL **local** ordering assumption: order can be specified **explicitly**

## Mapping TDL to TTCN-3

- Mapping: Behaviour
  - capture tester perspective only
  - only locally ordered so far
  - functions for each component
  - combined behaviours
    - split for each participating component
  - interactions
    - split into test and/or receive
  - deviations from behaviour
    - altsteps activated as defaults

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ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

# Mapping TDL to TTCN-3: Behaviour

```
Test Description Implementation TD_7_1_3_1
  uses configuration defaultTC {

    SS.g sends pdcch (c_rnti=ue) to UE.g;
    SS.g sends mac_pdu to UE.g;
    UE.g sends harq_ack to SS.g with {
        test objectives : TP1 ;
    };

    set verdict to PASS ;
    SS.g sends pdcch (c_rnti=unknown) to UE.g;
    SS.g sends mac_pdu to UE.g;

    alternatively {
        UE.g sends harq_ack to SS.g ;
        set verdict to FAIL ;
    } or {
        gate SS.g is quiet for five ;
        set verdict to PASS ;
    } with {
        test objectives : TP2 ;
    }
}
```

```
altstep to_handle_deviations_from_TDL_description_AS () {
  [] any port.receive {
    setverdict(fail);
    mtc.stop;
  }
  //if nothing happens, a timer shall be started
  //before every receive instruction
  //and the timer must be here
  //or we can leave the timeout for
  //the execute instruction called with the optional
  //timer parameter - but in this case
  //the final verdict will be 'error'
}

altstep quiescence_handler_AS (timer quiescence) {
  //for all quiescence that is not connected to a gate
  [] any port.receive{
     setverdict(fail);
     mtc.stop;
   }
   [] quiescence.timeout {
     setverdict(pass);
   }
}
```

# Mapping TDL to TTCN-3: Behaviour

```
Test Description Implementation TD_7_1_3_1
  uses configuration defaultTC {

    SS.g sends pdcch (c_rnti=ue) to UE.g;
    SS.g sends mac_pdu to UE.g;
    UE.g sends harq_ack to SS.g with {
        test objectives : TP1 ;
    };

    set verdict to PASS ;
    SS.g sends pdcch (c_rnti=unknown) to UE.g;
    SS.g sends mac_pdu to UE.g;

    alternatively {
        UE.g sends harq_ack to SS.g ;
        set verdict to FAIL ;
    } or {
        gate SS.g is quiet for five ;
        set verdict to PASS ;
    } with {
        test objectives : TP2 ;
    }
}
```

```
function behaviourOfTESTER_SS() runs on defaultCT {
  timer quiescence;

  activate(to_handle_deviations_from_TDL_description_AS());

  g_to_map.send(modifies pdcch := {c_rnti := ue})
  g_to_map.send(mac_pdu);
  g_to_map.receive(harq_ack);
  setverdict(pass);
  /*Test Objective Statisfied:  TP2 */

  g_to_map.send(modifies pdcch := {c_rnti := unknown});
  g_to_map.send(mac_pdu);

  quiescence.start(five);
  alt{
    [] g_to_map.receive(harq_ack){
         setverdict(fail);
    }
    [] quiescence_handler_AS(quiescence);
    /*Test Objective Statisfied:  TP2 */
  }
}
```

# Mapping TDL to TTCN-3: Behaviour

```
Test Description Implementation TD_7_1_3_1
  uses configuration defaultTC {

    SS.g sends pdcch (c_rnti=ue) to UE.g;
    SS.g sends mac_pdu to UE.g;
    UE.g sends harq_ack to SS.g with {
        test objectives : TP1 ;
    };

    set verdict to PASS ;
    SS.g sends pdcch (c_rnti=unknown) to UE.g;
    SS.g sends mac_pdu to UE.g;

    alternatively {
        UE.g sends harq_ack to SS.g ;
        set verdict to FAIL ;
    } or {
        gate SS.g is quiet for five ;
        set verdict to PASS ;
    } with {
        test objectives : TP2 ;
    }
}
```

```
testcase TD_7_1_3_1() runs on MTC_CT
    system defaultCT
{
  activate(to_handle_deviations_from_TDL_description_AS());

  defaultTC();

  TESTER_SS.start(behaviourOfTESTER_SS());

  all component.done;
}
```

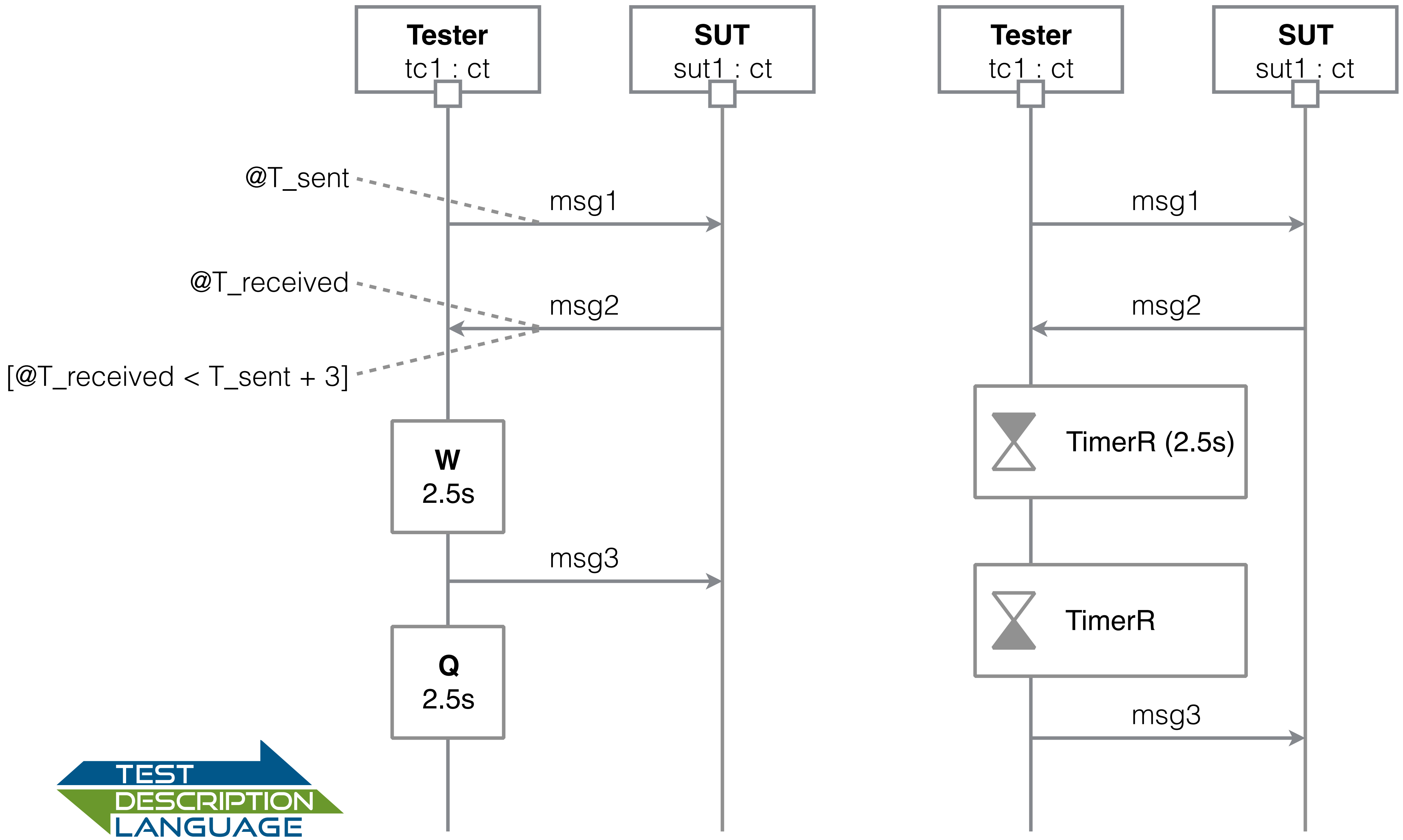
# Mapping TDL to TTCN-3

- Assumptions: Time
  - TTCN-3
    - timers and timer operations
    - realtime extension
  - TDL
    - timers and timer operations
    - time operations (wait, quiescence)
    - time labels and time constraints

ETSI ES 203 119-6 V1.1.1 (2018-06)

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

## Mapping TDL to TTCN-3



# Mapping TDL to TTCN-3

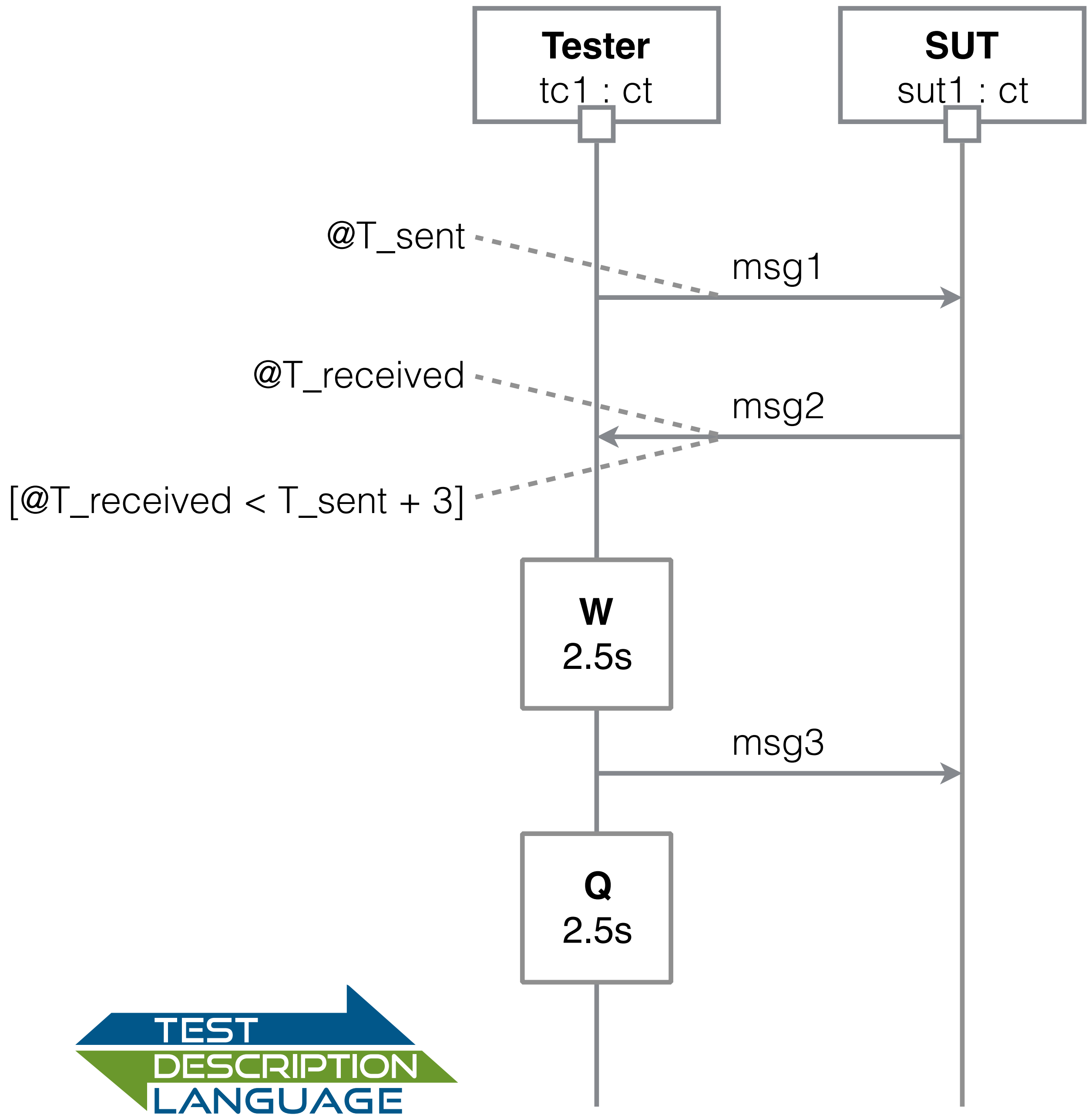
- Mapping: Time
  - all concepts expressed by timers
  - local time keeping per component
  - time constraints challenging

ETSI ES 203 119-6 V1.1.1 (2018-06)

ETSI STANDARD

**Methods for Testing and Specification (MTS);**
**The Test Description Language (TDL);**
**Part 6: Mapping to TTCN-3**

# Mapping TDL to TTCN-3: Time

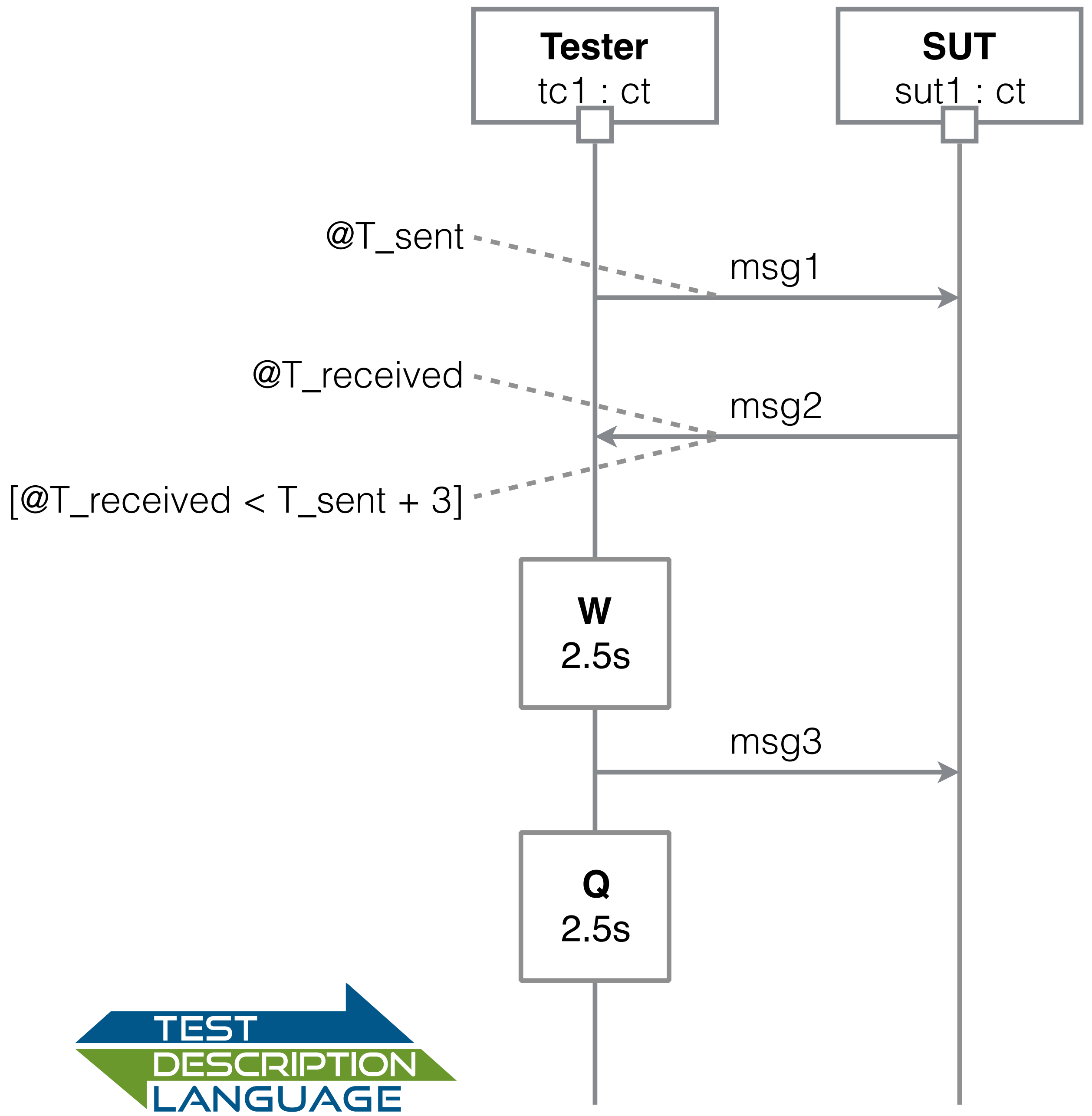


```
function behaviourOfTESTER_tc1() runs on ct {
    timeKeeper.start(forever)

    g.send(msg1);
    //Time label
    var float T_sent := timeKeeper.read;

    g.receive(msg2);
    var float T_received := timeKeeper.read;
    //Time constraint
    if (T_received > T_sent + 3) {
        setverdict(fail);
        mtc.stop;
    }
    //...
}
```

# Mapping TDL to TTCN-3: Time



```
function behaviourOfTESTER_tc1() runs on ct {
    //...

    //Wait
    timer T1_wait_1;
    var default wh := activate(Wait_handler_AS());
    T1_wait_1.start(2.5);
    T1_wait_1.timeout;
    deactivate(wh);

    g.send(msg3);

    //Quiescence
    timer T1_quiescence_1;
    T1_quiescence_1.start(2.5);
    alt {
        [] T1_quiescence_1.timeout {setverdict (pass);}
        [] any port.check(receive) {setverdict (fail);}
    }
}

altstep Wait_handler_AS() {
    //for suppressing handling of unexpected behaviour
    [] any port.check(receive) {repeat;}
}
```

## Mapping TDL to TTCN-3

- Everything else
  - packages -> modules
  - element imports -> imports
  - annotations ->
    - comments
    - special instructions
    - code (TTCN3Code)
  - test objectives -> comments
  - comments -> comments

ETSI ES 203 119-6 V1.1.1 (2018-06)

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

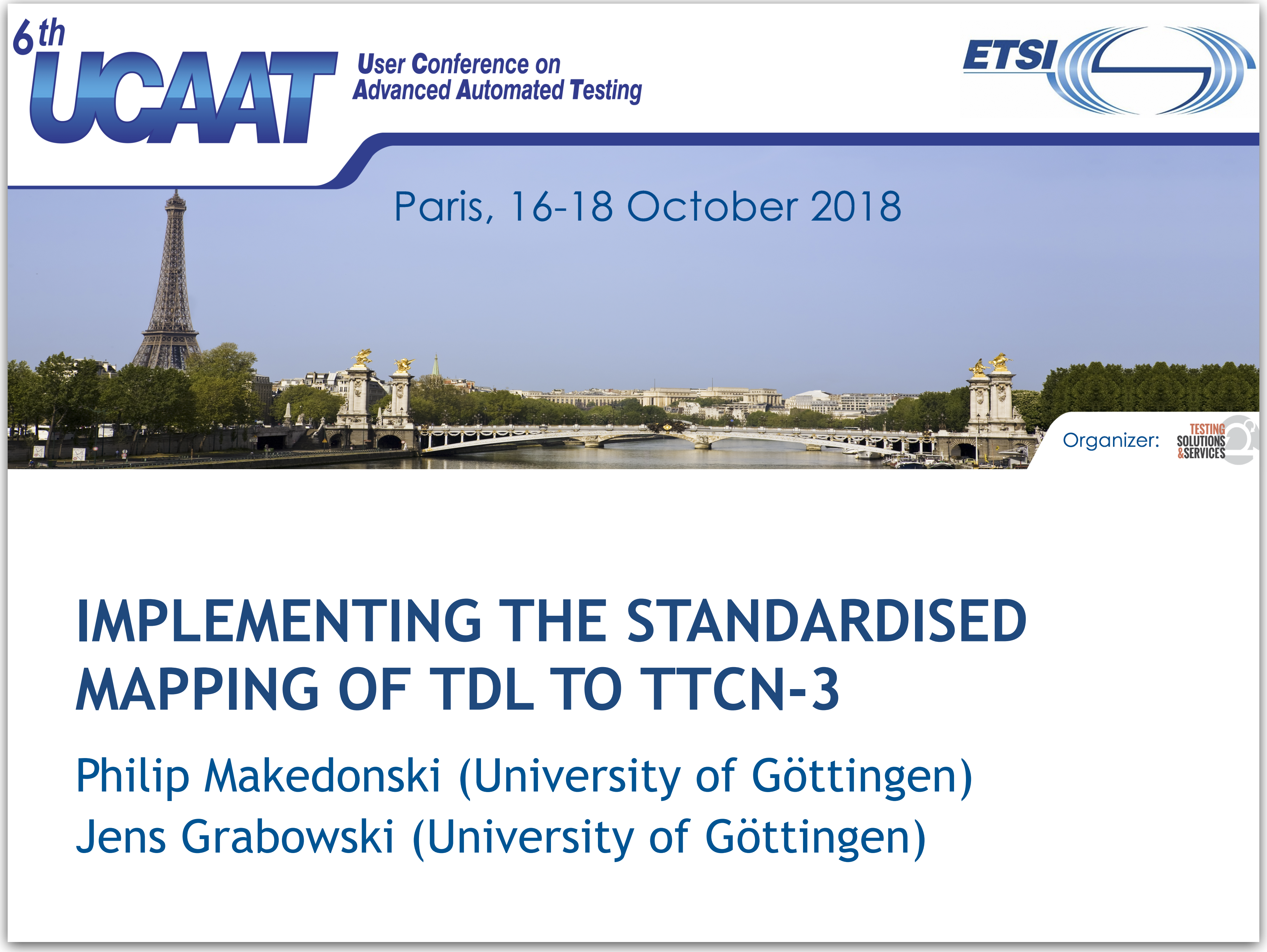
## Concluding remarks

- Rapid initial growth
  - becoming more and more stable
- Open-source project for essential tool support
  - accelerate adoption, validate standards
- Custom tools can be put together in a matter of hours
  - basic, yet capable, make early adoption easier
- Advanced solutions still require additional effort
  - not immediately necessary to get started with using TDL

## Concluding remarks

- Mapping may seem straightforward at first
  - but things can get very complicated the closer one looks
  - both languages have evolved to become rather complex
- Identify assumptions and semantic gaps
  - some restrictions may not be immediately obvious
  - some concepts may not be mappable at all in a useful way
  - adaptations to both languages can make mappings easier
  - some assumptions may need to be challenged
- A standardised mapping defines baseline expectations
  - tool- and user-specific can be optionally applied on top

# Coming up: Thursday, 14:20



6th UCAAT User Conference on Advanced Automated Testing

ETSI

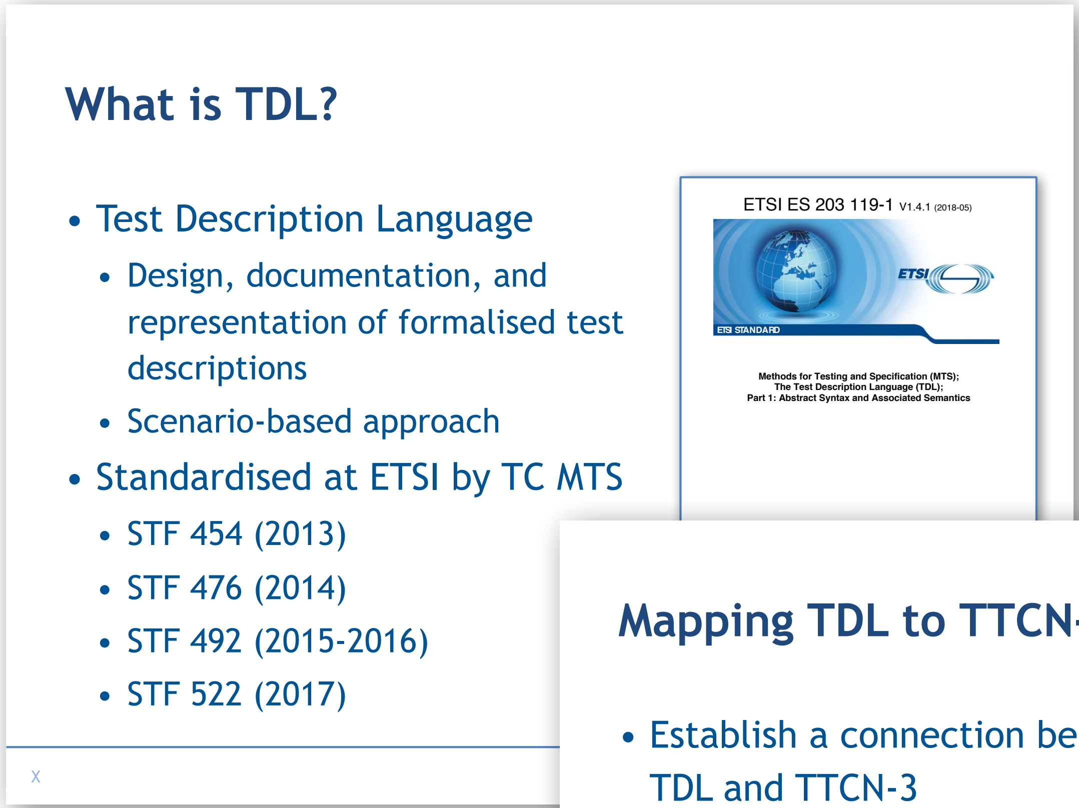
Paris, 16-18 October 2018

Organizer: TESTING SOLUTIONS & SERVICES

**IMPLEMENTING THE STANDARDISED MAPPING OF TDL TO TTCN-3**

Philip Makedonski (University of Göttingen)
Jens Grabowski (University of Göttingen)

# Summary



### What is TDL?

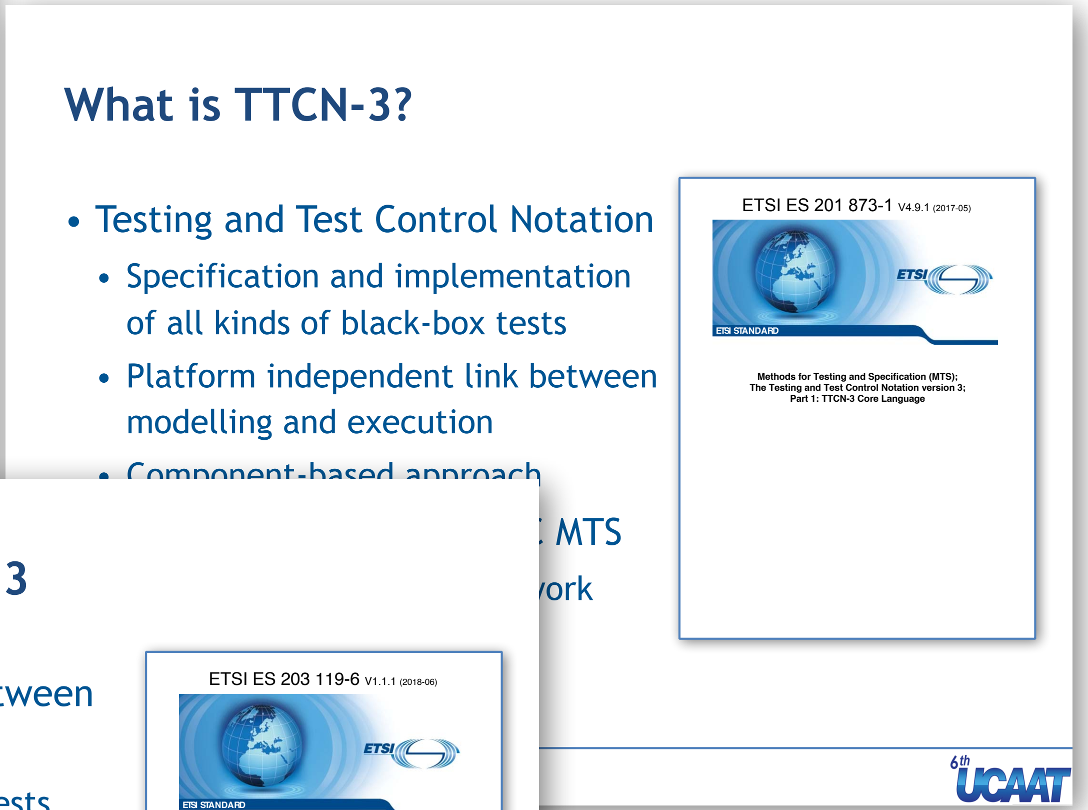
- Test Description Language
  - Design, documentation, and representation of formalised test descriptions
  - Scenario-based approach
- Standardised at ETSI by TC MTS
  - STF 454 (2013)
  - STF 476 (2014)
  - STF 492 (2015-2016)
  - STF 522 (2017)

ETSI ES 203 119-1 V1.4.1 (2018-05)

ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 1: Abstract Syntax and Associated Semantics

x



### What is TTCN-3?

- Testing and Test Control Notation
  - Specification and implementation of all kinds of black-box tests
  - Platform independent link between modelling and execution
  - Component-based approach

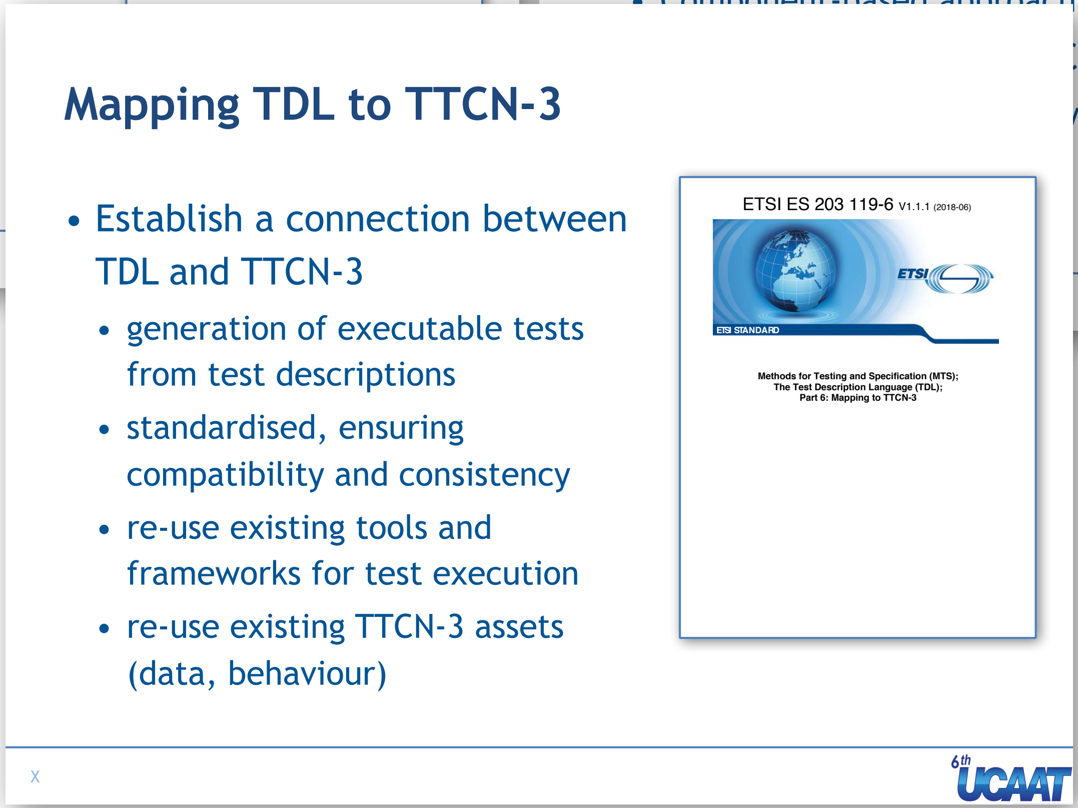
MTS

ork

ETSI ES 201 873-1 V4.9.1 (2017-05)

ETSI STANDARD

Methods for Testing and Specification (MTS);
The Testing and Test Control Notation version 3;
Part 1: TTCN-3 Core Language



### Mapping TDL to TTCN-3

- Establish a connection between TDL and TTCN-3
  - generation of executable tests from test descriptions
  - standardised, ensuring compatibility and consistency
  - re-use existing tools and frameworks for test execution
  - re-use existing TTCN-3 assets (data, behaviour)

ETSI ES 203 119-6 V1.1.1 (2018-06)

ETSI STANDARD

Methods for Testing and Specification (MTS);
The Test Description Language (TDL);
Part 6: Mapping to TTCN-3

x

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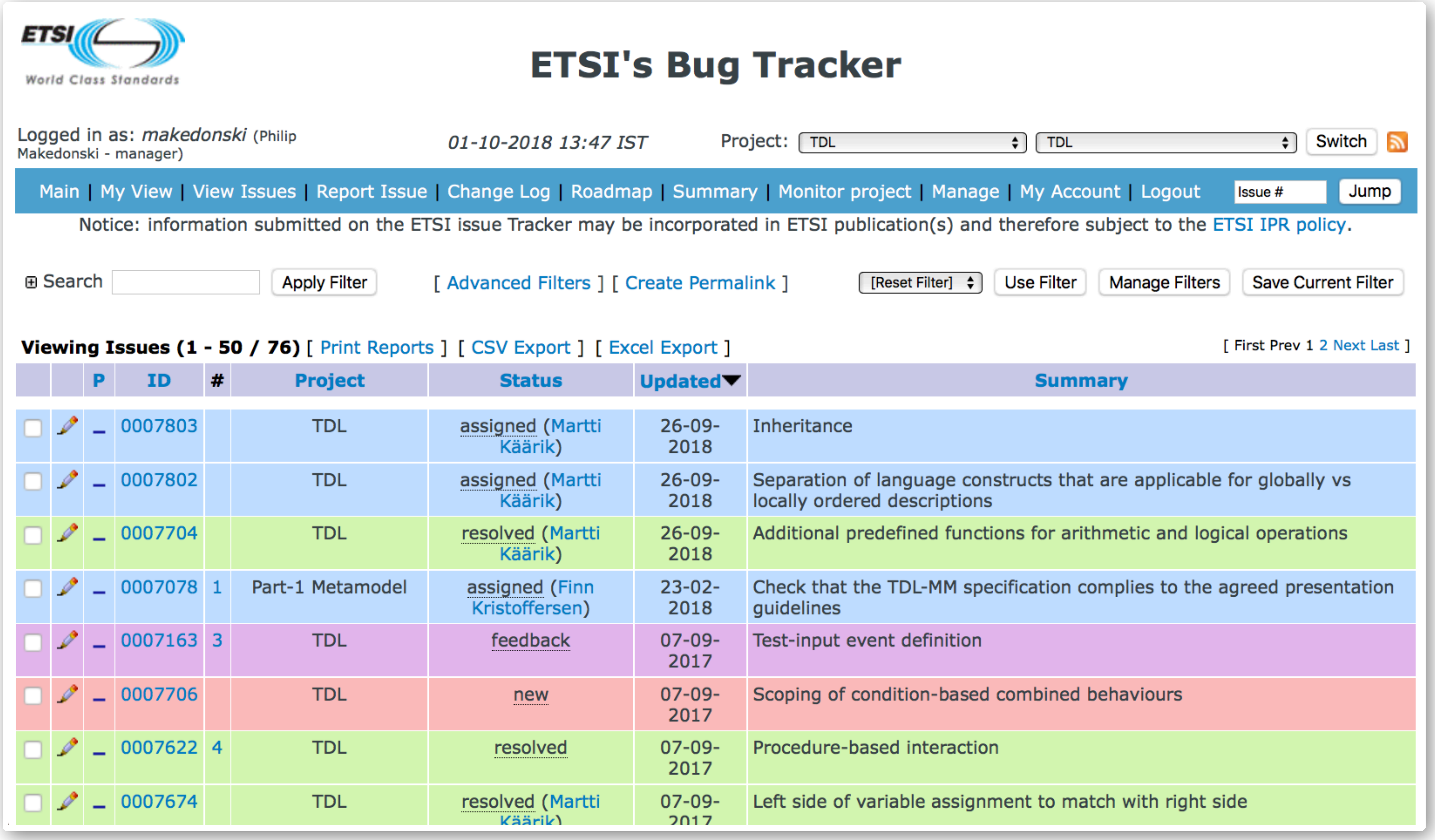
# What would you want to see in TDL?



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|---|---|---|---|---|---|---|---|---|
| | | – | 0007803 | | TDL | assigned (Martti Käärik) | 26-09-2018 | Inheritance |
| | | – | 0007802 | | TDL | assigned (Martti Käärik) | 26-09-2018 | Separation of language constructs that are applicable for globally vs locally ordered descriptions |
| | | – | 0007704 | | TDL | resolved (Martti Käärik) | 26-09-2018 | Additional predefined functions for arithmetic and logical operations |
| | | – | 0007078 | 1 | Part-1 Metamodel | assigned (Finn Kristoffersen) | 23-02-2018 | Check that the TDL-MM specification complies to the agreed presentation guidelines |
| | | – | 0007163 | 3 | TDL | feedback | 07-09-2017 | Test-input event definition |
| | | – | 0007706 | | TDL | new | 07-09-2017 | Scoping of condition-based combined behaviours |
| | | – | 0007622 | 4 | TDL | resolved | 07-09-2017 | Procedure-based interaction |
| | | – | 0007674 | | TDL | resolved (Martti Käärik) | 07-09-2017 | Left side of variable assignment to match with right side |

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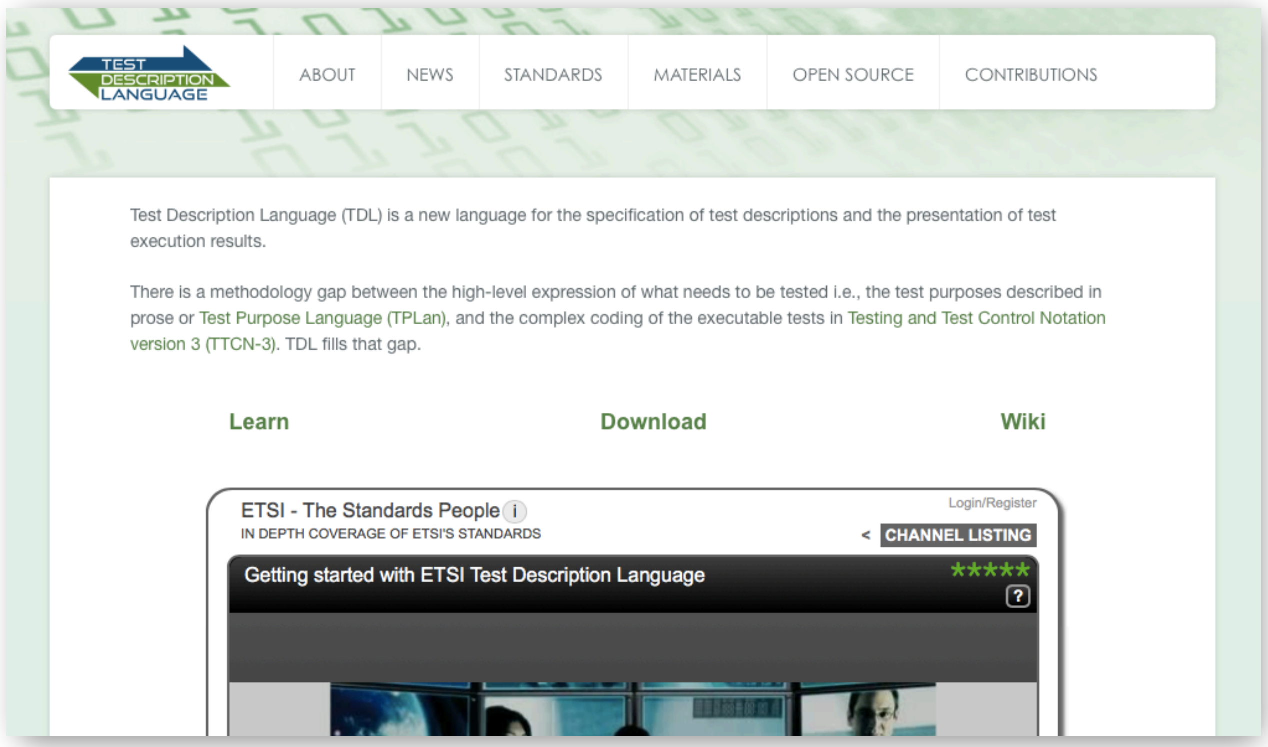
# What would you want to see in TDL?



Test Description Language (TDL) is a new language for the specification of test descriptions and the presentation of test execution results.

There is a methodology gap between the high-level expression of what needs to be tested i.e., the test purposes described in prose or Test Purpose Language (TPLan), and the complex coding of the executable tests in Testing and Test Control Notation version 3 (TTCN-3). TDL fills that gap.

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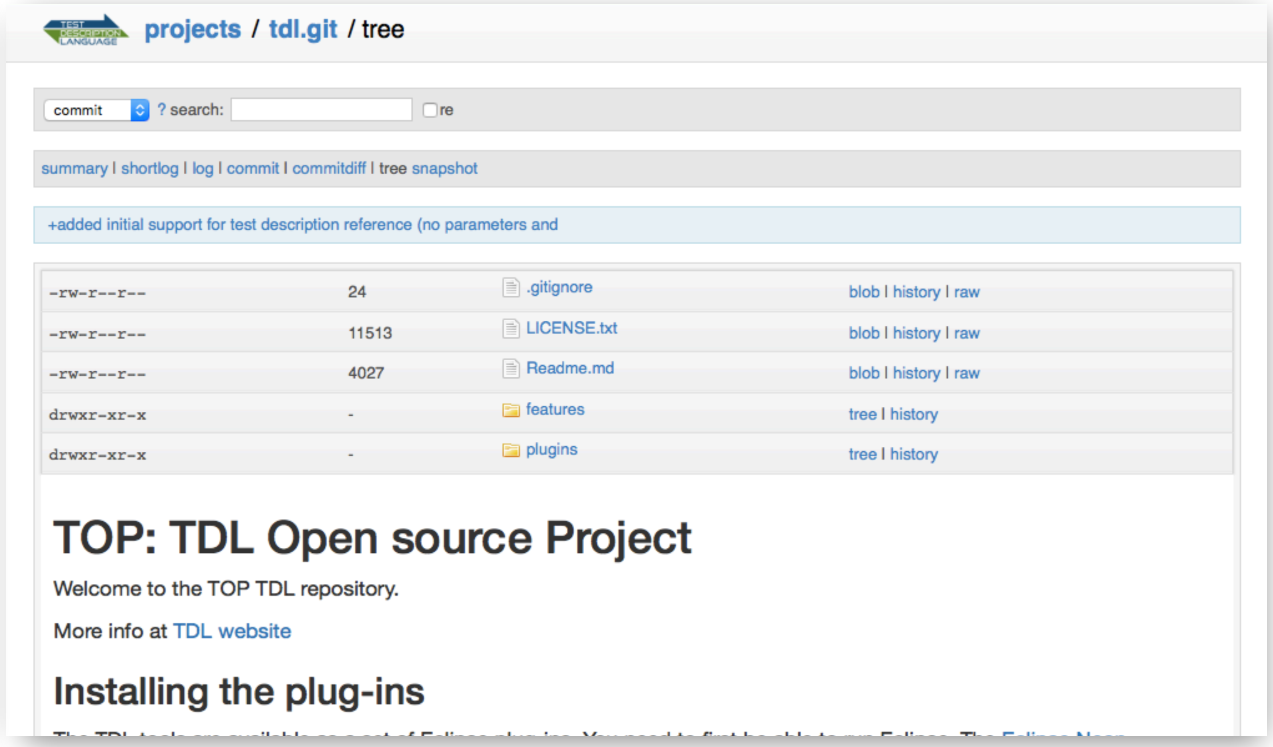
Getting started with ETSI Test Description Language


projects / tdl.git / tree
commit
? search:
re
summary | shortlog | log | commit | commitdiff | tree snapshot

+added initial support for test description reference (no parameters and

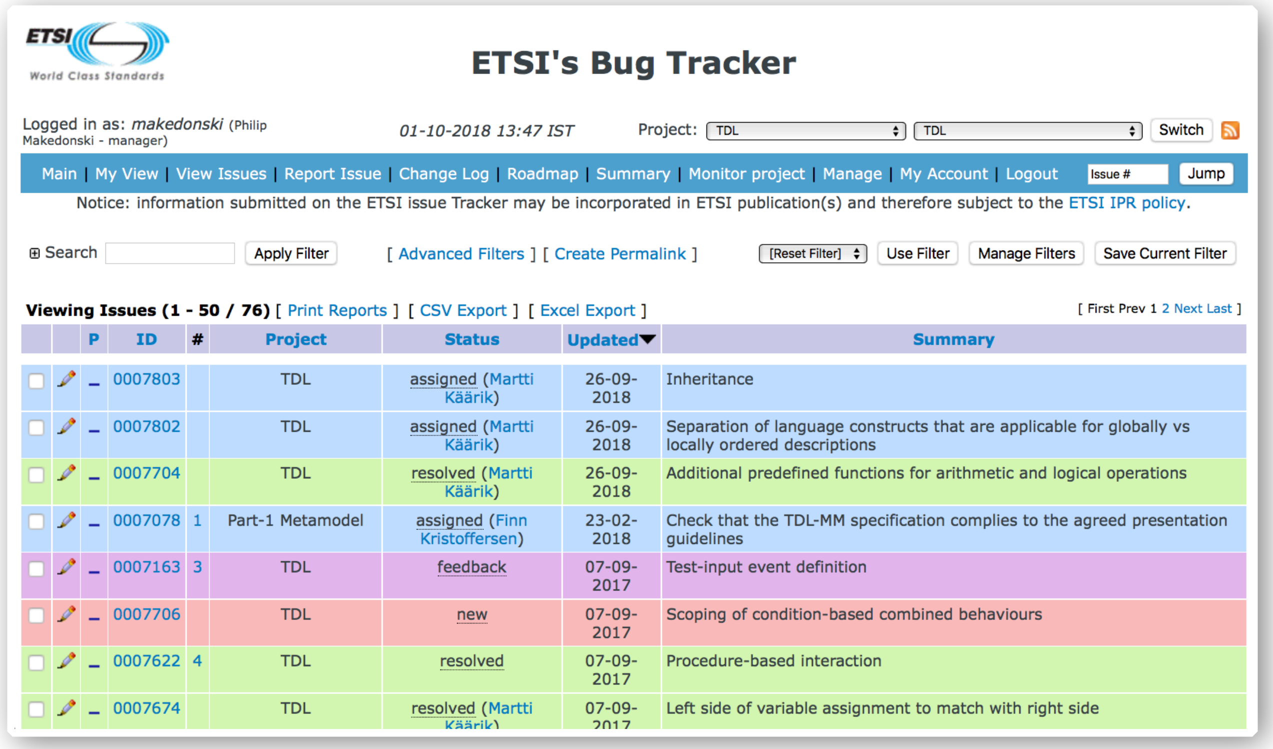
| | | | |
|---|---|---|---|
| -rw-r--r-- | 24 | .gitignore | blob \| history \| raw |
| -rw-r--r-- | 11513 | LICENSE.txt | blob \| history \| raw |
| -rw-r--r-- | 4027 | Readme.md | blob \| history \| raw |
| drwxr-xr-x | - | features | tree \| history |
| drwxr-xr-x | - | plugins | tree \| history |

## TOP: TDL Open source Project

Welcome to the TOP TDL repository.

More info at TDL website

## Installing the plug-ins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# From TDL to TTCN-3

Philip Makedonski
Martti Käärik

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