Introduction to TTCN-3

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the test language
for telecom and datacom

Overview

- Introduction
  - TTCN Testing Background
  - Future Testing Challenges
- The TTCN-3 Language
  - Background
  - Example
- TTCN-3 in Practice
  - Current Status
  - Future Outlook

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Test Language

Why use a standardized test language ?

To **know** what we are testing !

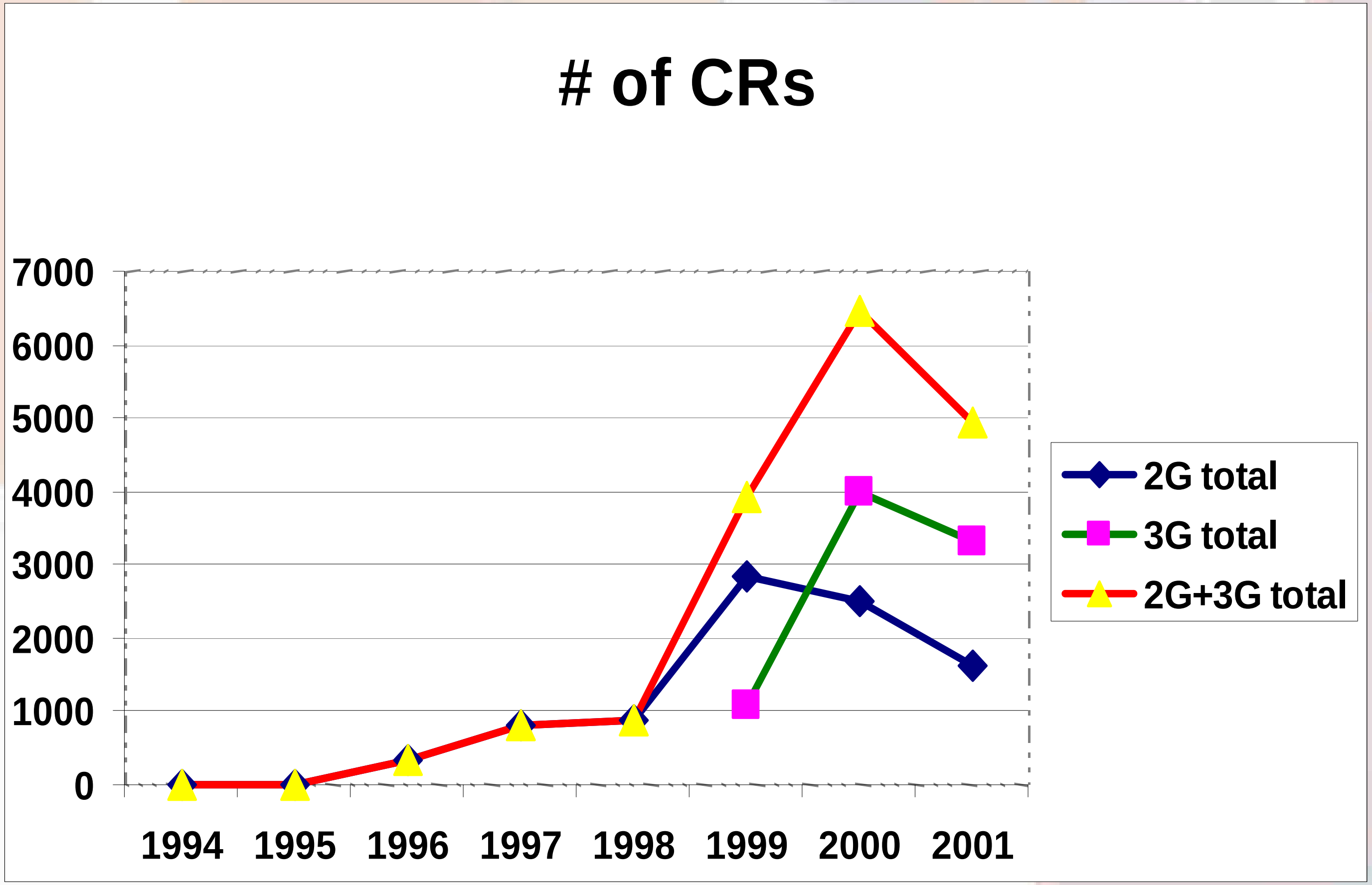
Only if you can unambigously specify a test case, you can know what you are testing.

TTCN-2

- designed purely for testing
- internationally standardized language
- well-established and widely used (TTCN-2)
- uses conformance testing methodology (ISO 9646)
- tool independent
- supports ASN.1

Testing Challenges

- Increasing complexity of products
  - Number of GSM Specifications 1306
  - Number of 3G Specifications 2290



NOKIA

Future Testing Challenges

- Pressure to shorten time to market
  - New systems and services must be available quicker
  - How can we reduce testing time?
- Pressure to improve quality
  - SW outage average time for Network elements measured in seconds per year
  - How can we improve testing quality (and quantify it)
- New types of testing
  - IP based protocols
  - Text based protocols
  - Unified testing approach for software and protocol testing
- Not unique to Telecomm industry
- Maybe proposed solutions are also general

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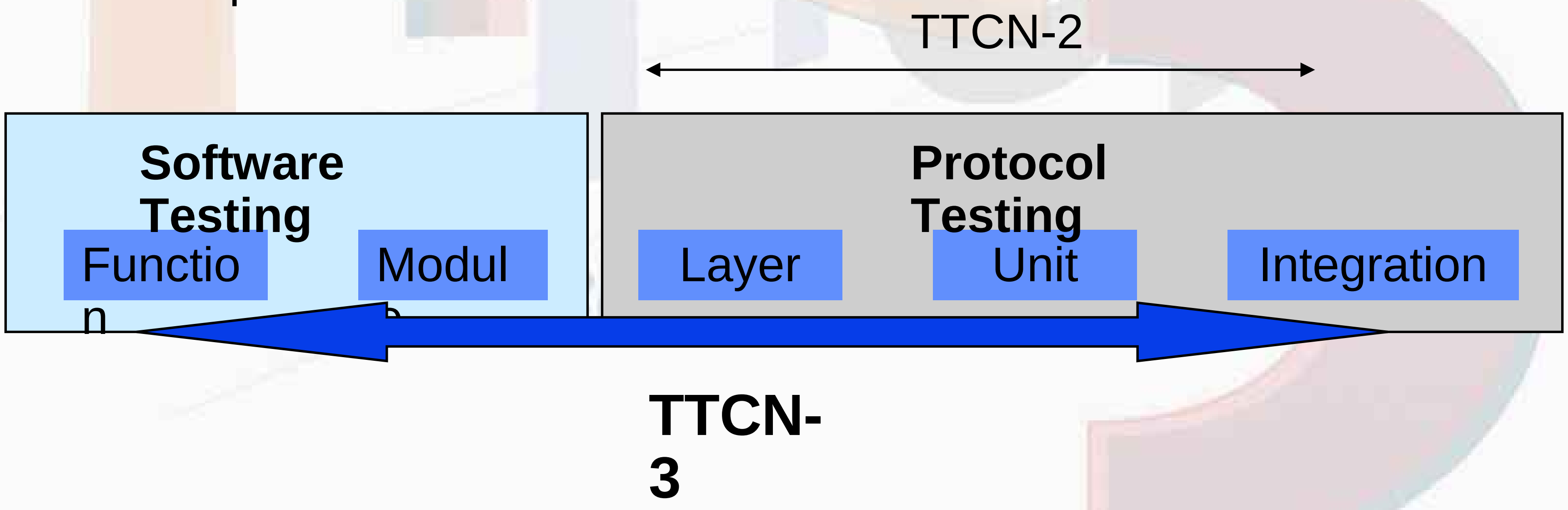
What is TTCN-3

- **T**est and **T**esting **C**ontrol **N**otation
- New Internationally standardized testing language for formally defining test scenarios. Designed purely for testing
- Taking the best bits of TTCN-2 and combining them with a new more powerful textual notation
- Tool Independent

```
testcase Hello_Stephan ()
{
        port.send("Hello Stephan");
        alt{
                []port.receive("Hello Colin")
                        {setverdict( pass)};
                [else]
                        {setverdict( inconc)}  //Stephan asleep!
        }
}
```

Why is TTCN-3 Important

- More Productive
  - Easier to learn
  - Easier to use
- More Powerful
  - Extended functionality
  - Support for IP protocol
  - Support text-based protocols
- More Flexable
  - Not tied to OSI model
  - For many types of testing
- More Extendable
  - Extensibility built-in



TTCN-2

Software Testing

Functio
n

Modul

Protocol Testing

Layer

Unit

Integration

TTCN-3

TTCN-3 Background

- STF 133 formed by ETSI MTS in 1997 to produce TTCN version 3
- Co-operation with ITU-T SG10
- Voluntary contributions from Nortel, Ericsson, Telelogic, Nokia etc.
- More than 200 members in STF133 discussion group.
- Language standardized in October 2000

TTCN-3: Standardisation

A Comparison of TTCN Language Versions

TTCN-2

- machine processable source file format (`.mp` files)
- tabular presentation format
- supports timers and message-based communication
- static test configurations
- static adaptation layer interface (PCOs)

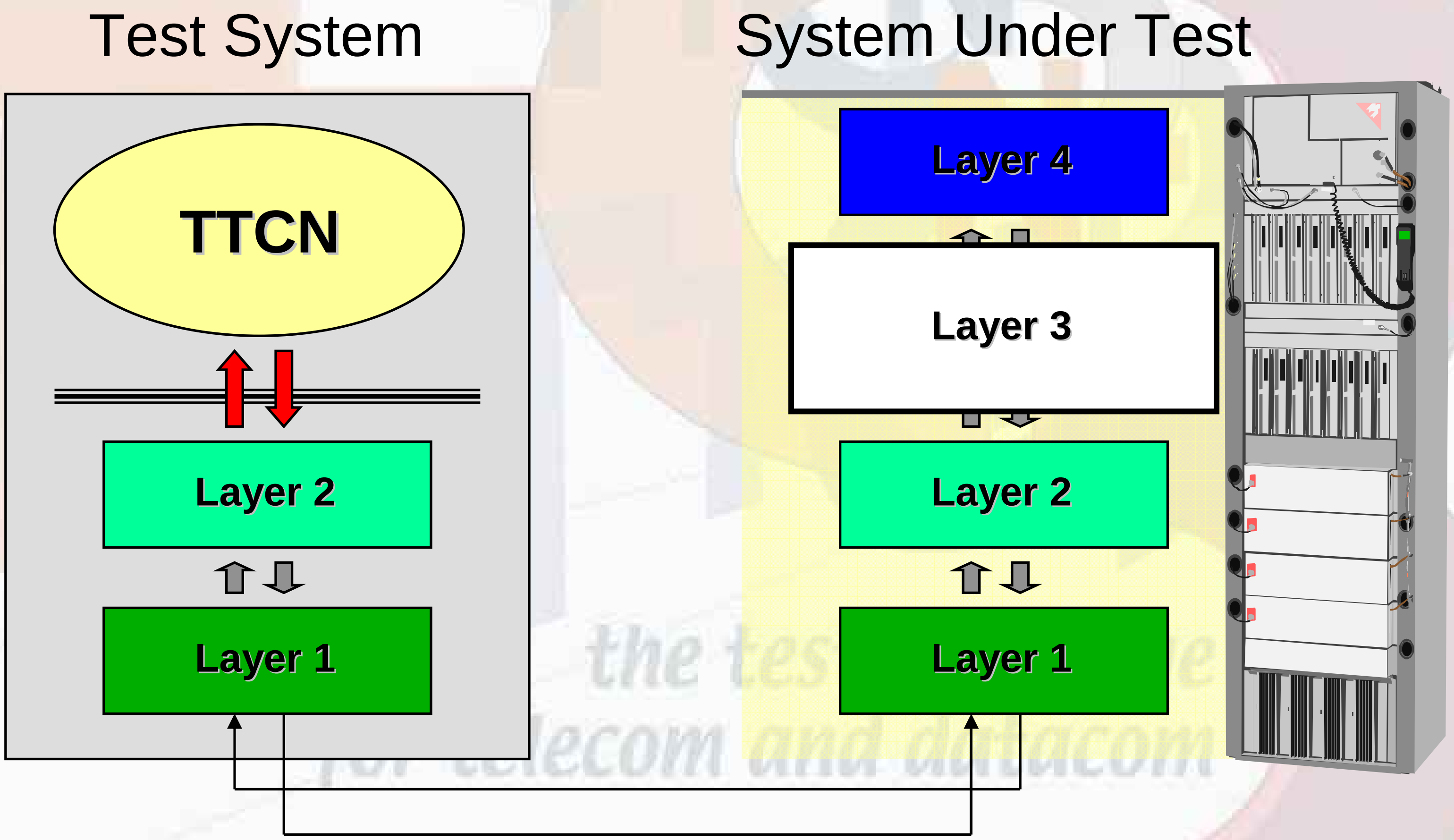
TTCN-3

- textual source file format (like programming language)
- tabular, graphical (MSC), or any user-defined presentation format
- supports timers, message-based *and* procedure-based communication, and external functions
- dynamic test configurations and one-to-many connections
- separate dynamic adaptation layer interface (`system` component)

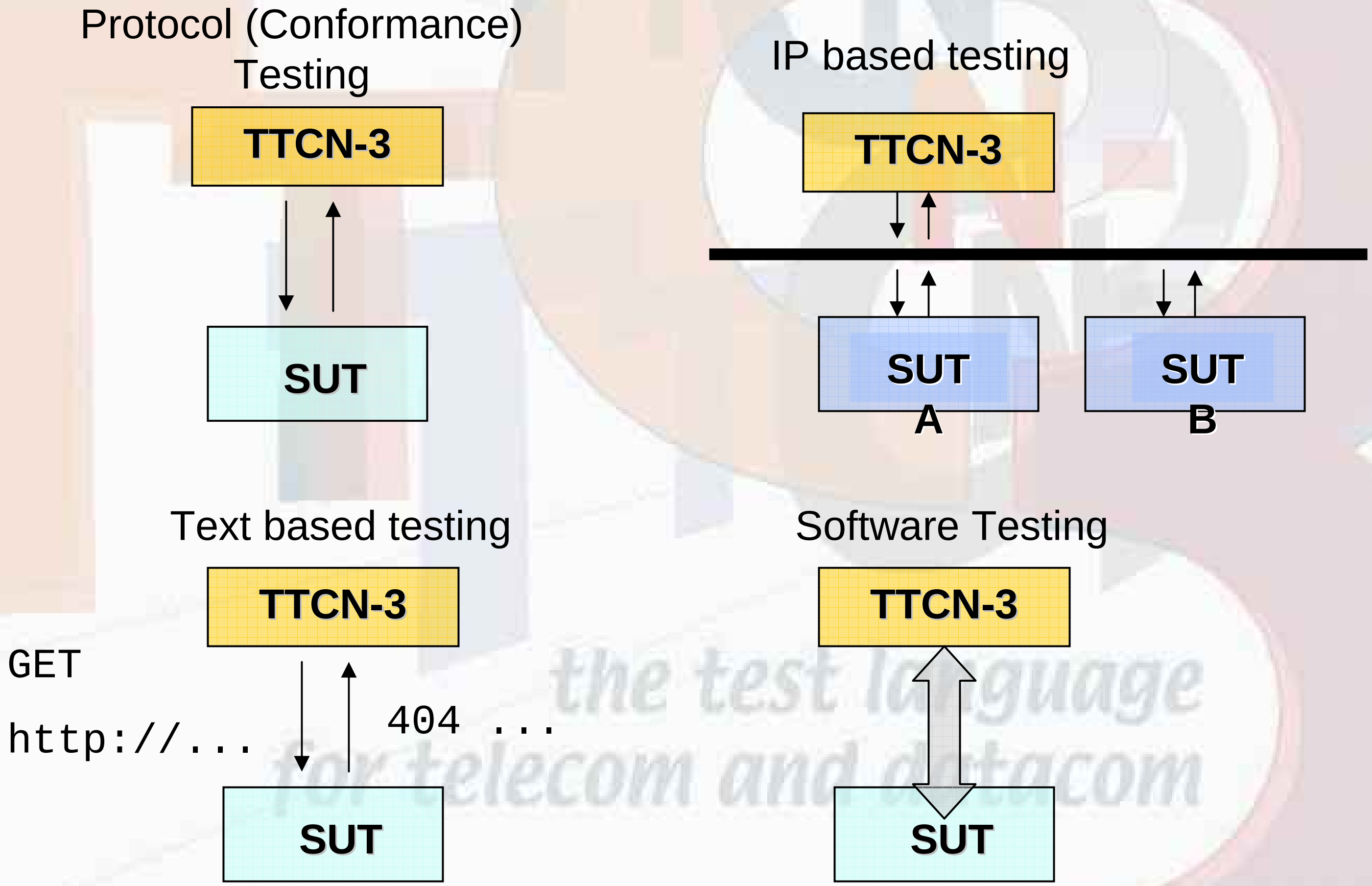
TTCN-3 Advantages

- Extend usability of TTCN-2
  - powerful features, e.g. different communication mechanisms
  - intended for several application areas
  - presentation formats independent of core language
  - standardized interfaces
- Do not reinvent
  - retain proven concepts of TTCN-2
  - retain TTCN-2 expertise of developers

Application area Conformance Testing



Application Areas



Protocol (Conformance) Testing

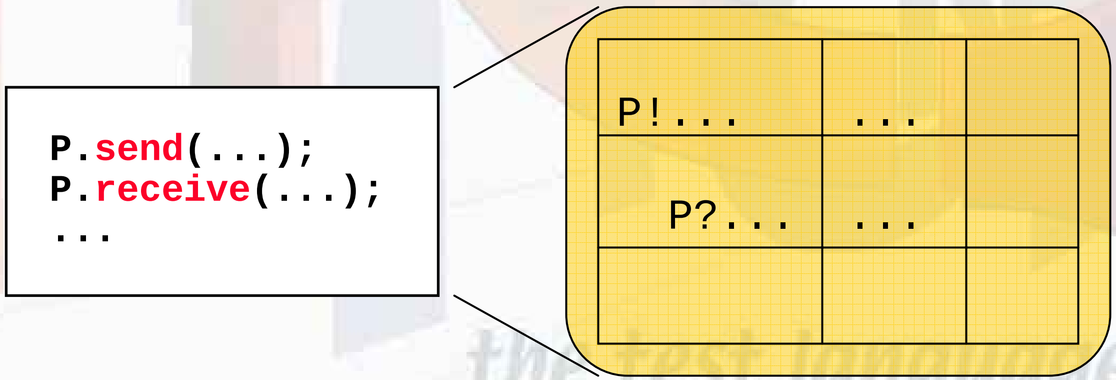
IP based testing

Text based testing

Software Testing

Separation of Content and Form

- TTCN-3 is based on textual core language



core language

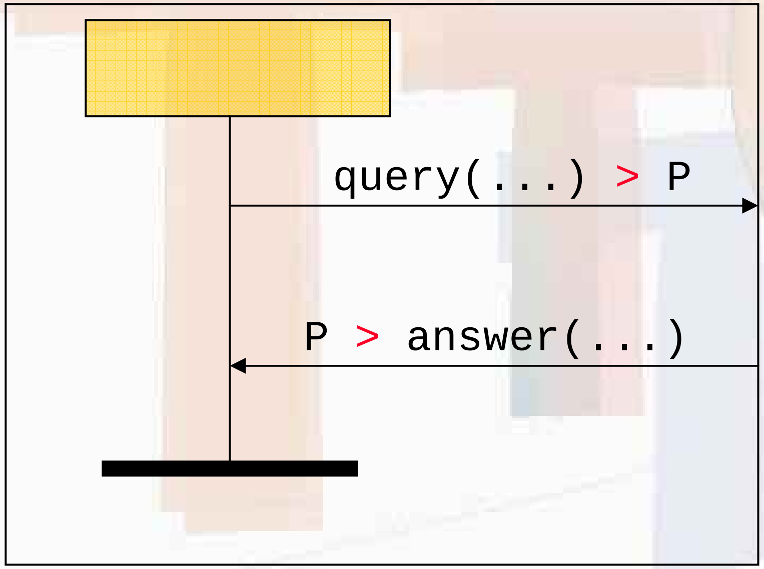
presentation format

```
P.send(...);
P.receive(...);
...
```

P!...	...	
P?...	...	

Separation of Content and Form (cont.)

- Further presentation formats supported



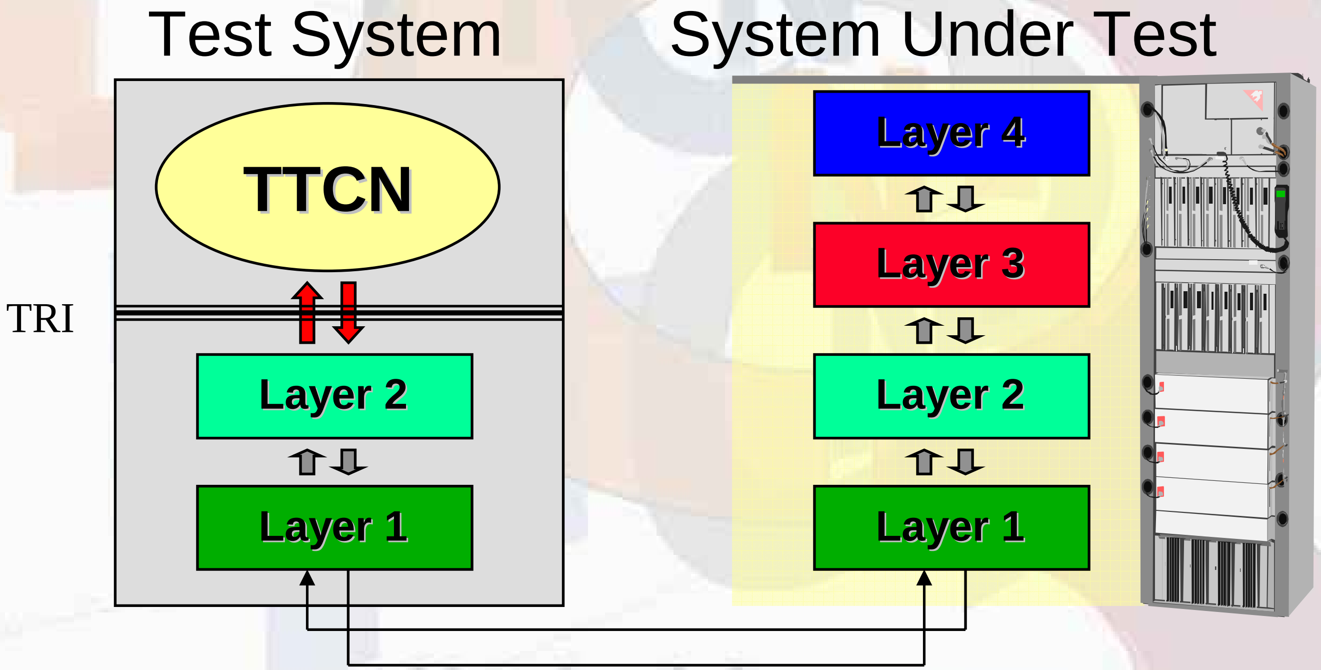
```
query(...) > P
P > answer(...)
```

graphical presentation format
(standardized)

```
P.receive("123")
P.send("4")
```

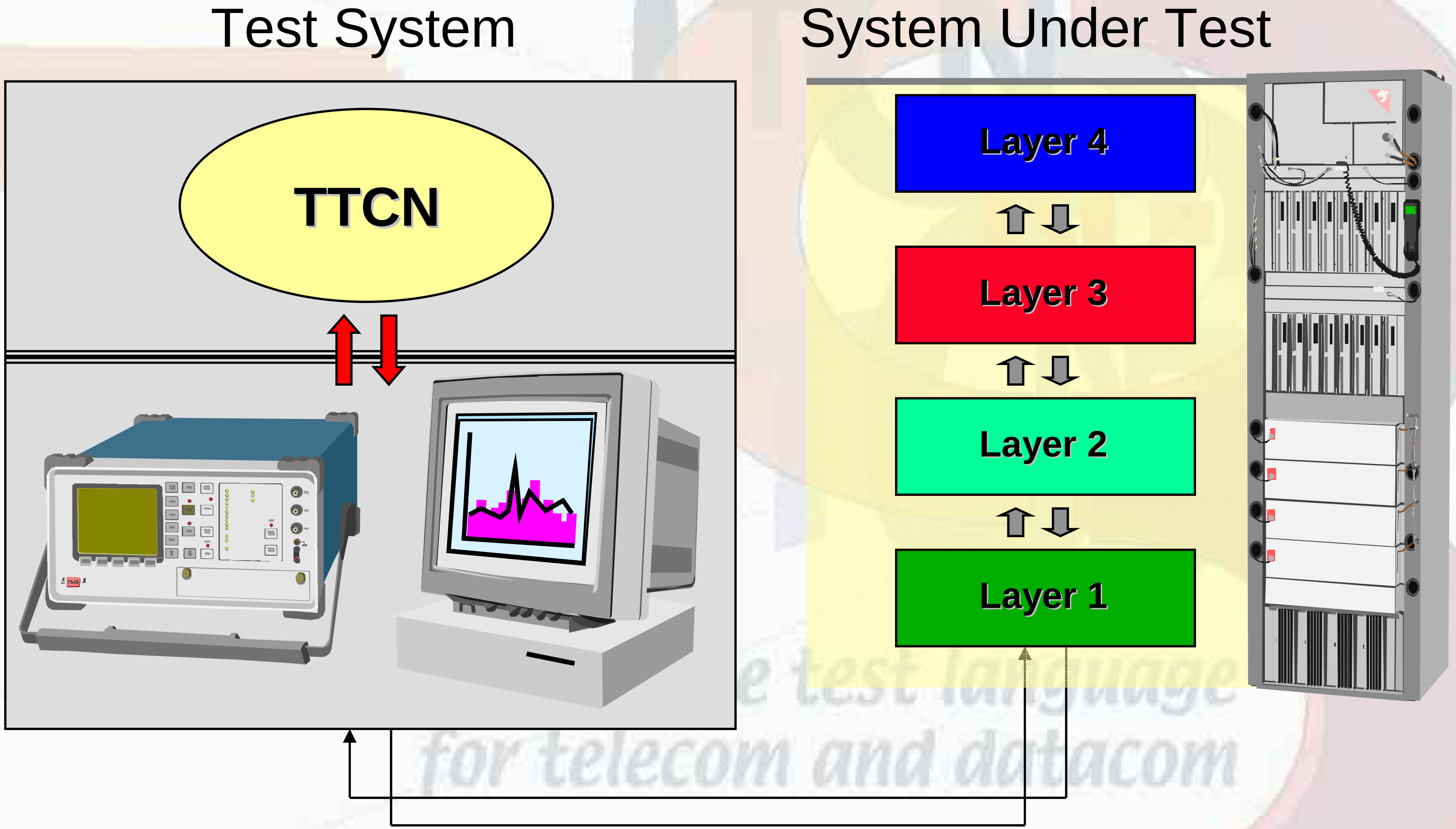
proprietary presentation format

Standardized TTCN-3 Runtime Interface (TRI)



- standardized interface between test suite and protocol layers
- allows independent development and portability

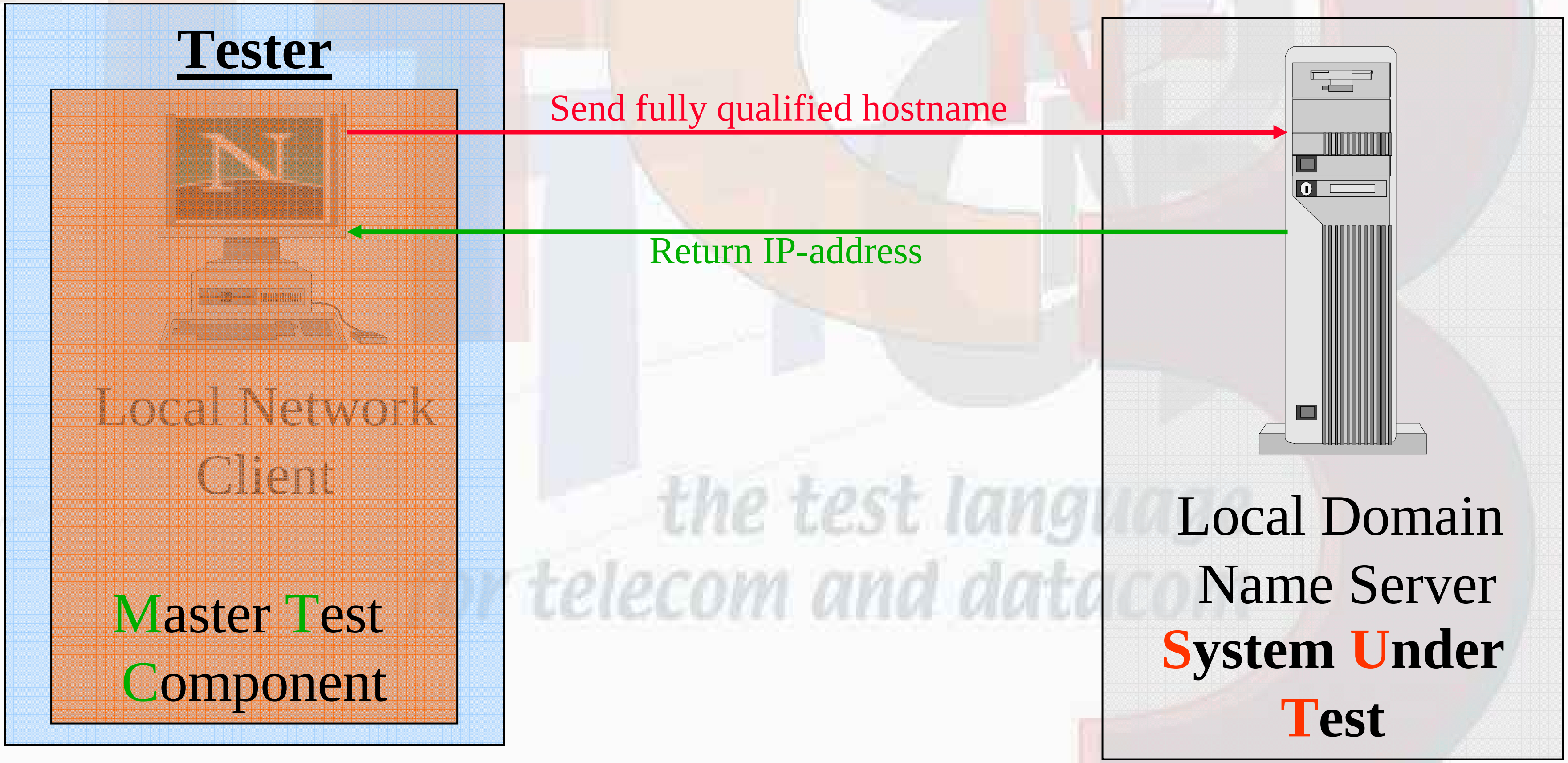
Standardized TTCN-3 Runtime Interface (TRI)



- testing tools supporting TRI can be integrated easily

TTCN-3 Step by Step: DNS Server

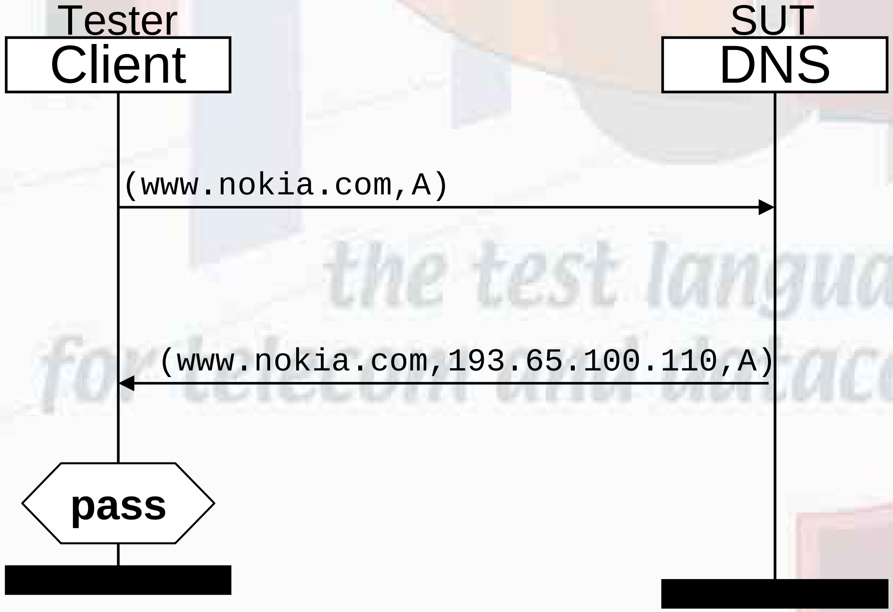
- TTCN-3 core notation is introduced by developing an example test case for a Domain Name Service (DNS) server



DNS Server – Test Purpose

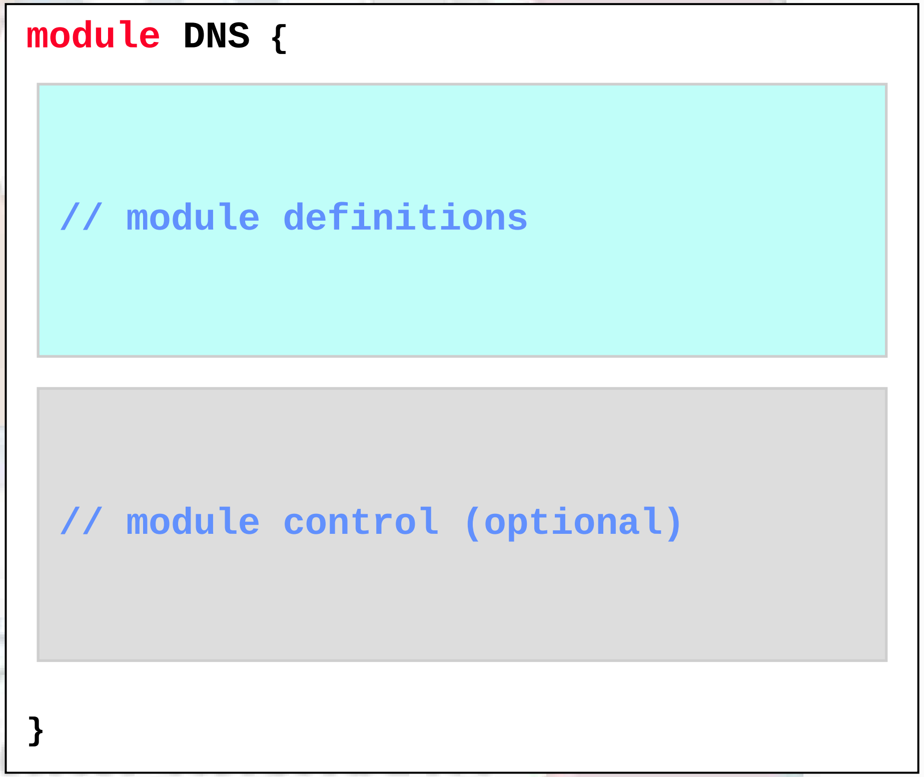
- The Internet's Domain Name System (DNS) service offers hostname to IP Address resolution
- Communication is message based (UDP)
- We want to test the correct resolution

www.nokia.com => 193.65.100.110



TTCN-3 Modules

- Main building block of TTCN-3 is a module
    - Unit of Compilation
    - Contains definitions
    - And an optional control part

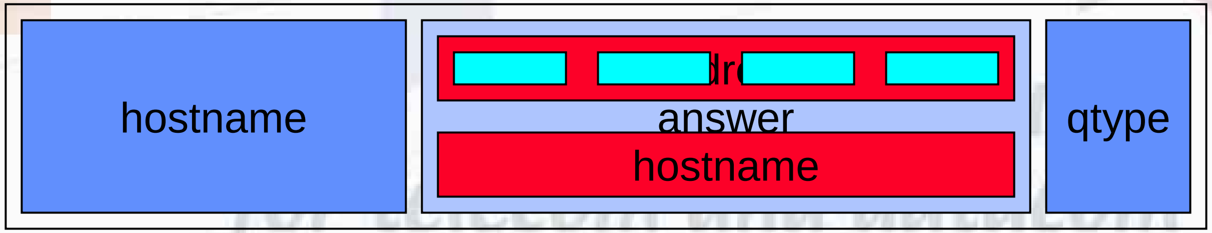


```
module DNS {

  // module definitions

  // module control (optional)

}
```

Module Definitions

- Module definitions
  - **Type definitions**
  - Templates
  - Port definitions
  - Component defs
  - Testcase
  - Control part

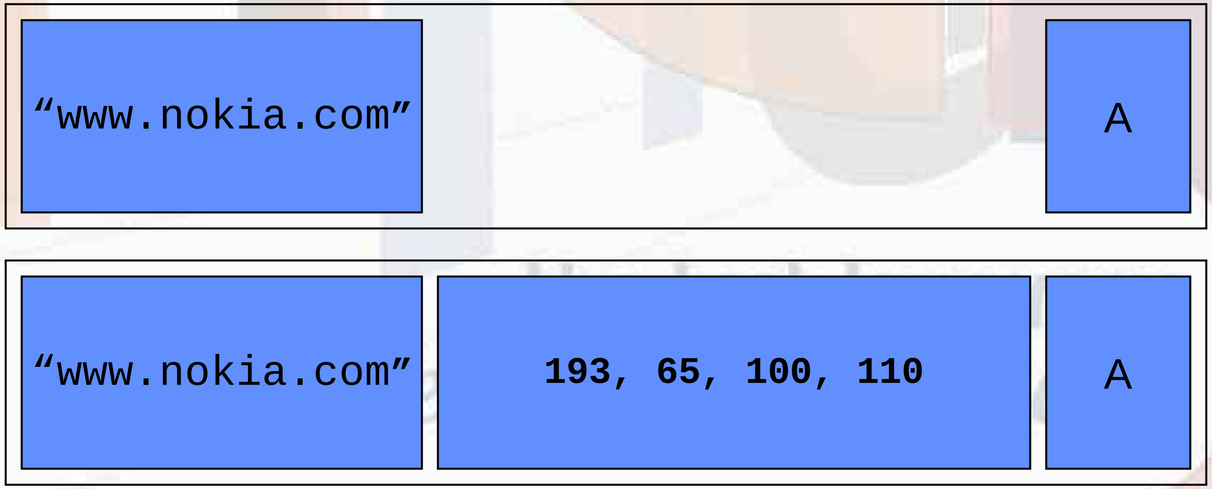
```
type record DNSQuery {
       charstring  hostname;
       AnswerType  answer optional;
       QueryType   qtype;
}
type union AnswerType {
       Byte        address[4],
       charstring  hostname;
}
type integer Byte (0 .. 255);
type enumeration QueryType {
       A, NS, CNAME, MX
}
```



Module Definitions contd.

- Module definitions
  - Type definitions
  - **Templates**
  - Port definitions
  - Component defs
  - Testcase
  - Control part

```
template DNSQuery query {
       hostname := “www.nokia.com”;
       answer   := omit;
       qtype    := A;
}

template DNSQuery answer modifies query {
       answer.address := {193,65,100,110};
}
```



“www.nokia.com” | A

“www.nokia.com” | 193, 65, 100, 110 | A

Module Definitions contd.

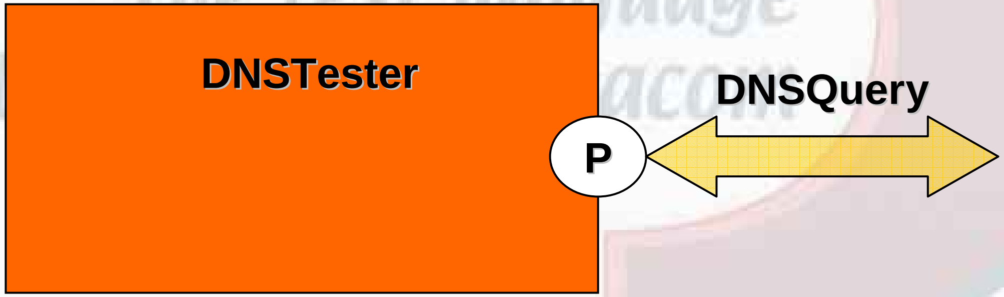
- Module definitions
  - Type definitions
  - Templates
  - **Port definitions**
  - **Component definitions**
  - Testcase
  - Control

Port definitions

```
type port DNSPort message {
       inout DNSQuery;

       // a port may send/receive messages
       // of more than one type
}
```

Component definitions

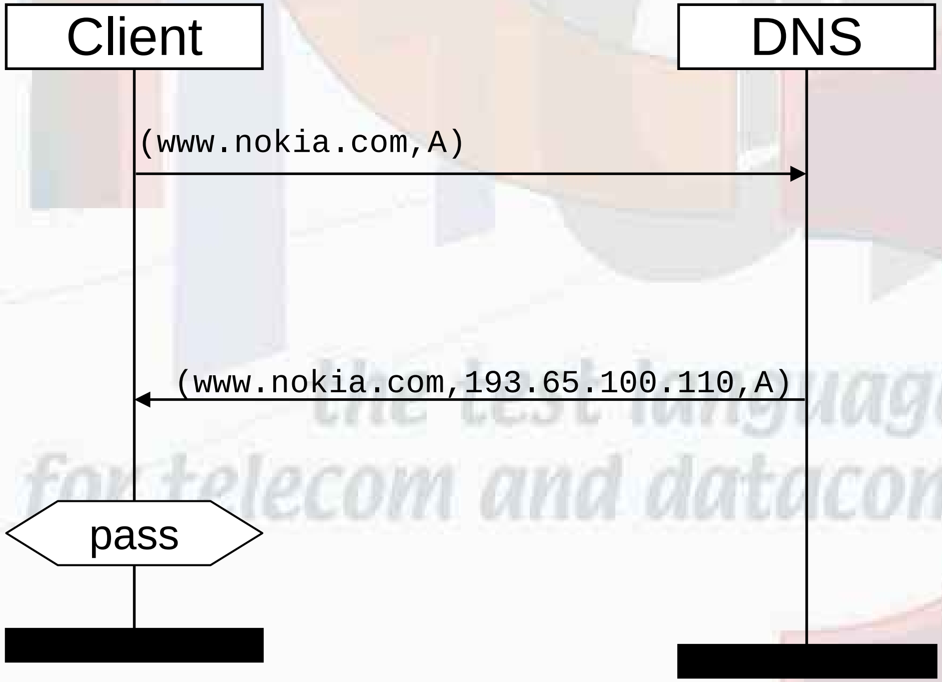
```
type component DNSTester {
       port DNSPort P;

       // a component may have more than one port
}
```



Module Definitions contd.

- Module definitions
  - Type definitions
  - Templates
  - Port definitions
  - Component defs
  - **Testcase**
  - Control part

```
testcase Testcase1() runs on DNSTester {
        P.send(query);
        P.receive(answer);
        setverdict(pass);
        stop;
}
// there may be more than one in a module
```



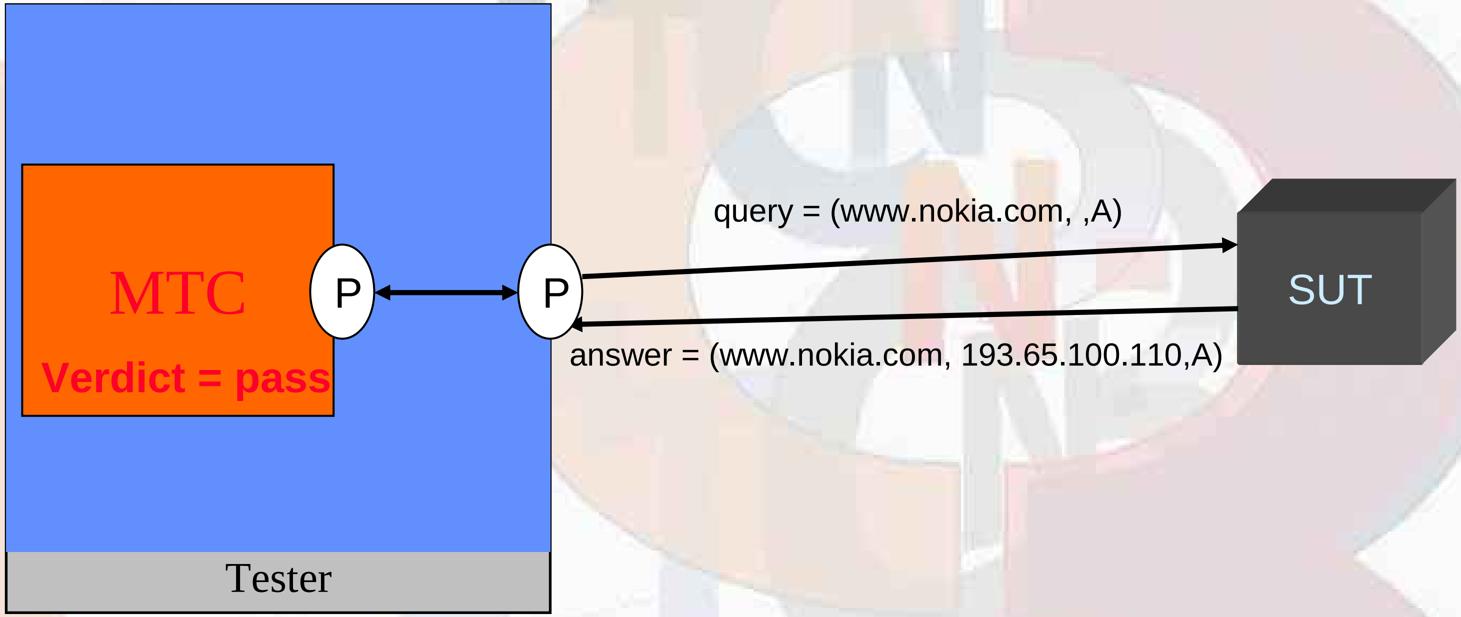
Module Definitions contd.

- Module definitions
  - Type definitions
  - Templates
  - Port defintions
  - Component defs
  - Testcase
  - **Control part**

- Controls the execution of test cases

```
control {

       execute(Testcase1());

       // more testcases might follow
       // C-like control structures available

}
```

Execution of a Test Case



MTC

Verdict = pass

P

P

Tester

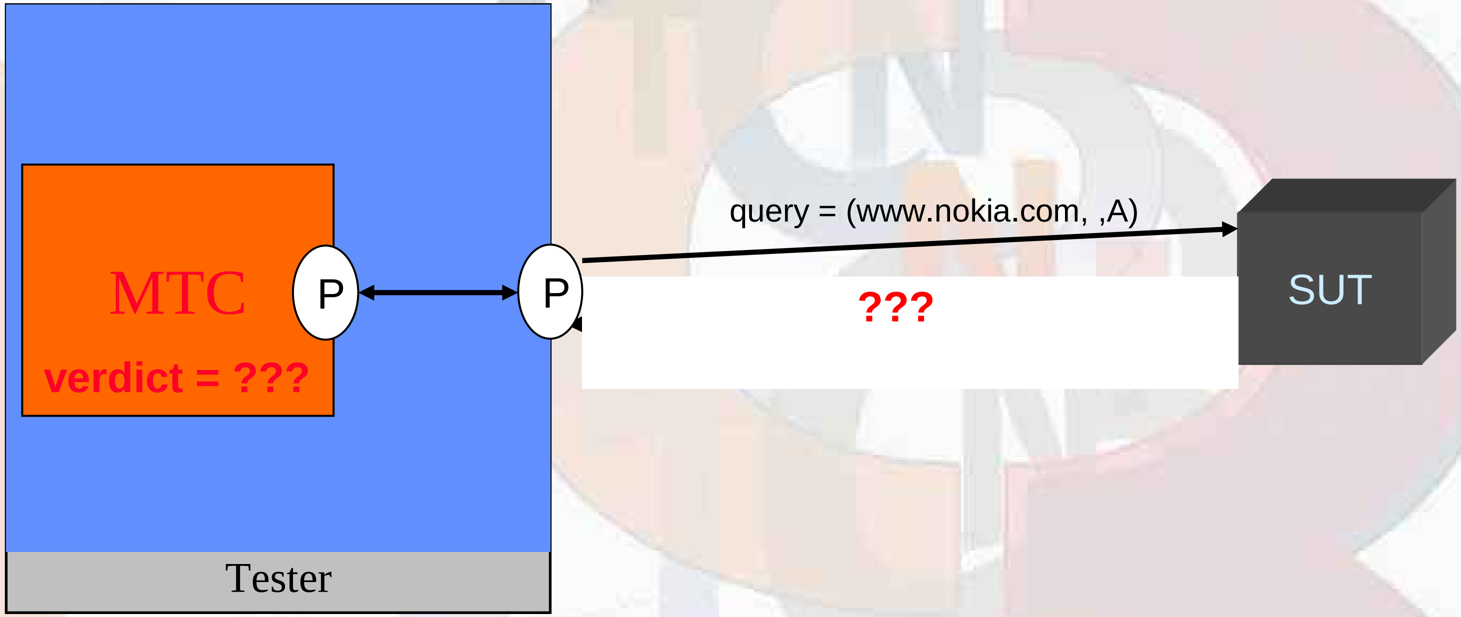
query = (www.nokia.com, ,A)

SUT

answer = (www.nokia.com, 193.65.100.110,A)

```
testcase Testcase1() runs on DNSTester {
       P.send(query);
       P.receive(answer);
        setverdict(pass);
       stop;
}
```

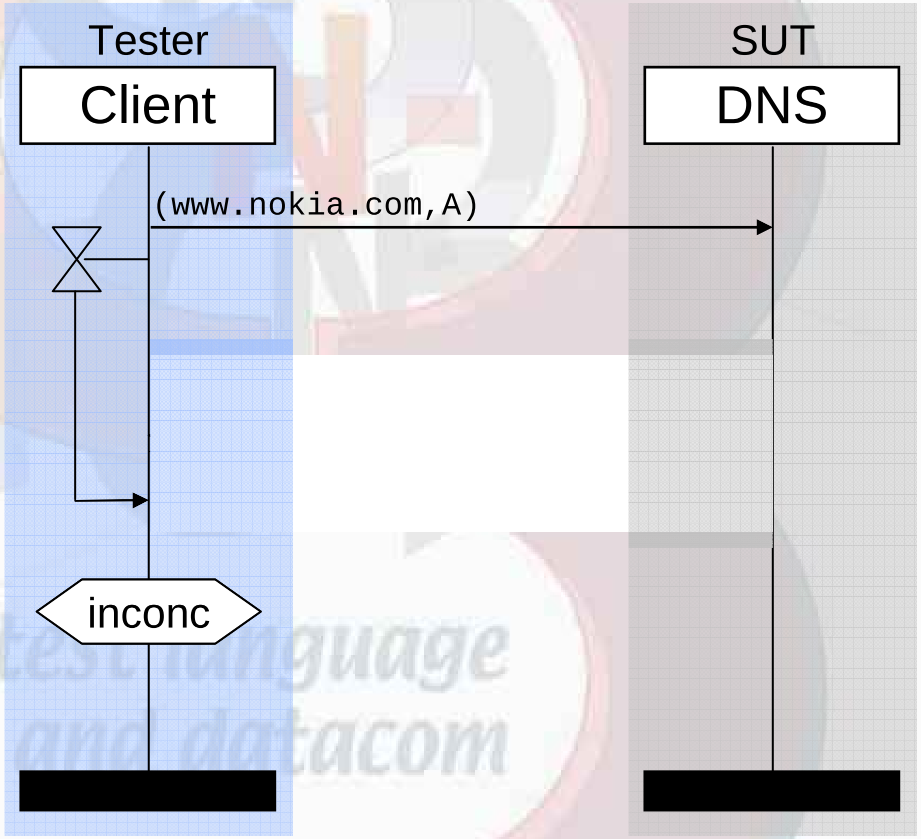
Dealing with erroneous behavior



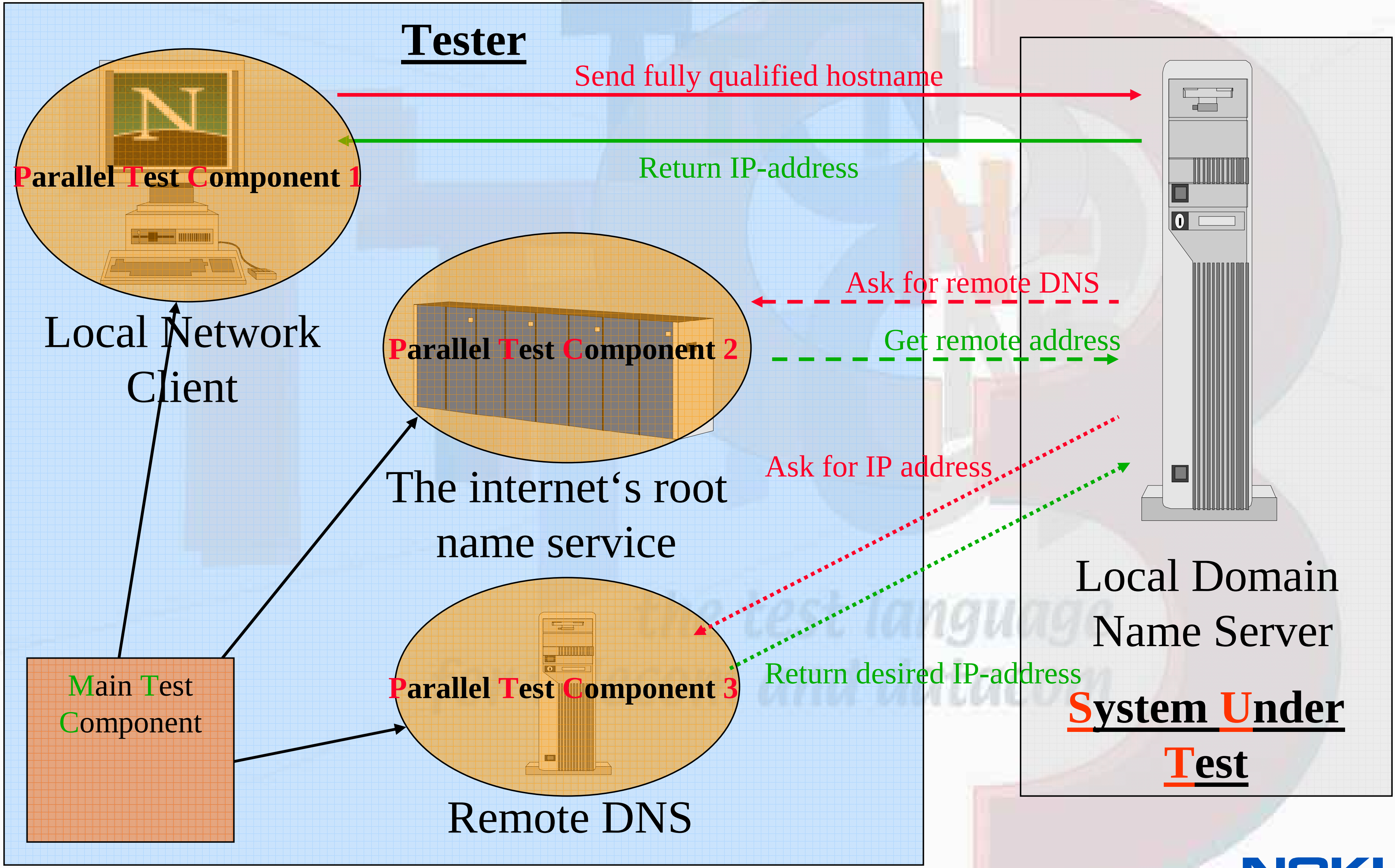
- `P.receive(answer)` **blocks** until it receives a message that matches `answer` .
- Any other message does not unblock the tester, which then blocks forever.
- If no message is received, the tester will also block forever.

Dealing with erroneous behavior contd.

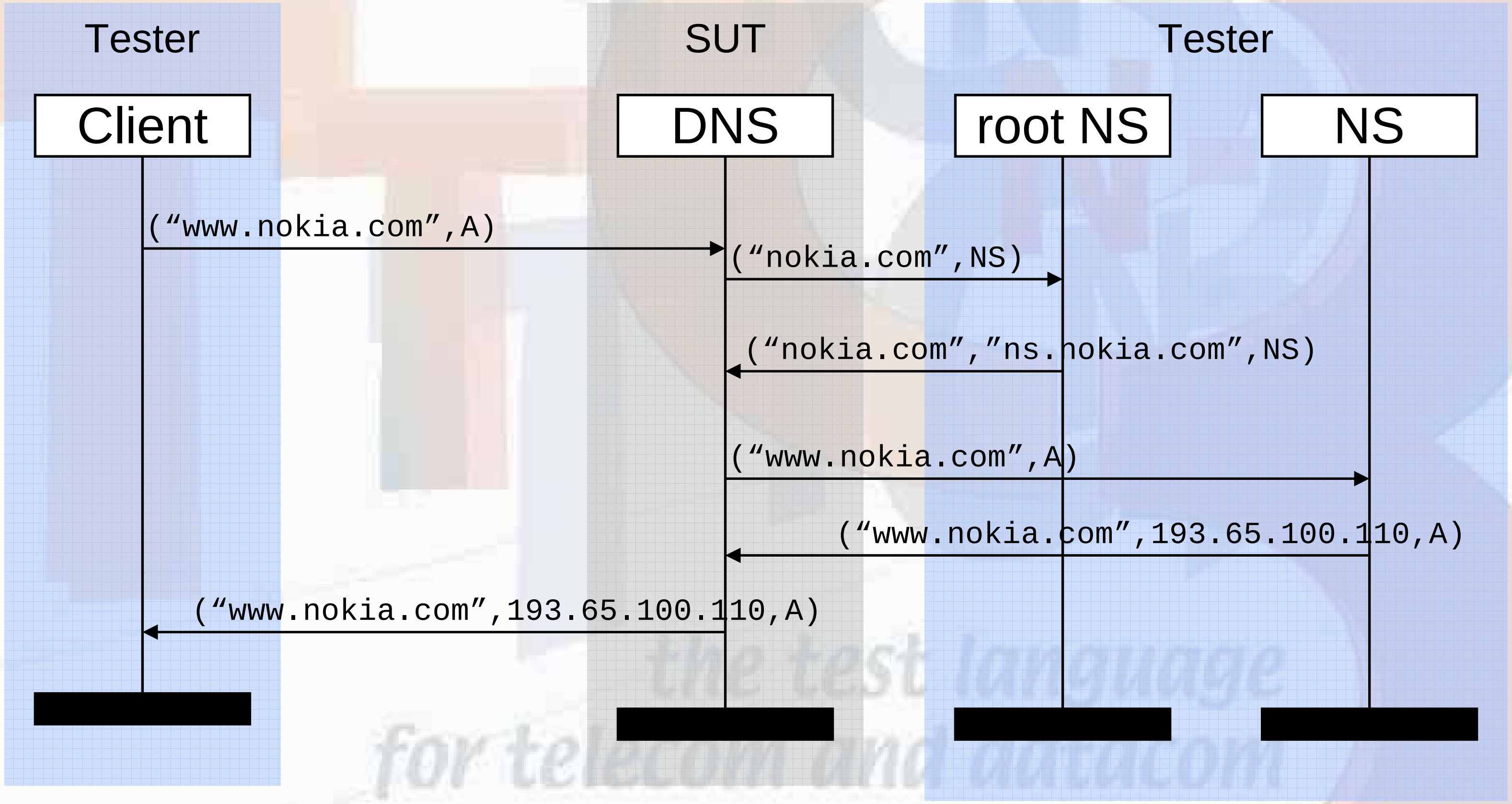
```
testcase Testcase2() runs on DNSTester {

       timer t := 5.0;
       P.send(query);

       t.start;

       alt {
               [] P.receive(answer) {
                       setverdict(pass);
               }
               [] P.receive { // any message
                       setverdict(fail);
               }
               [] t.timeout {
                       setverdict(inconc);
               }
       }
       stop;
}
```



Non-local DNS Query



Non-local DNS Query contd.

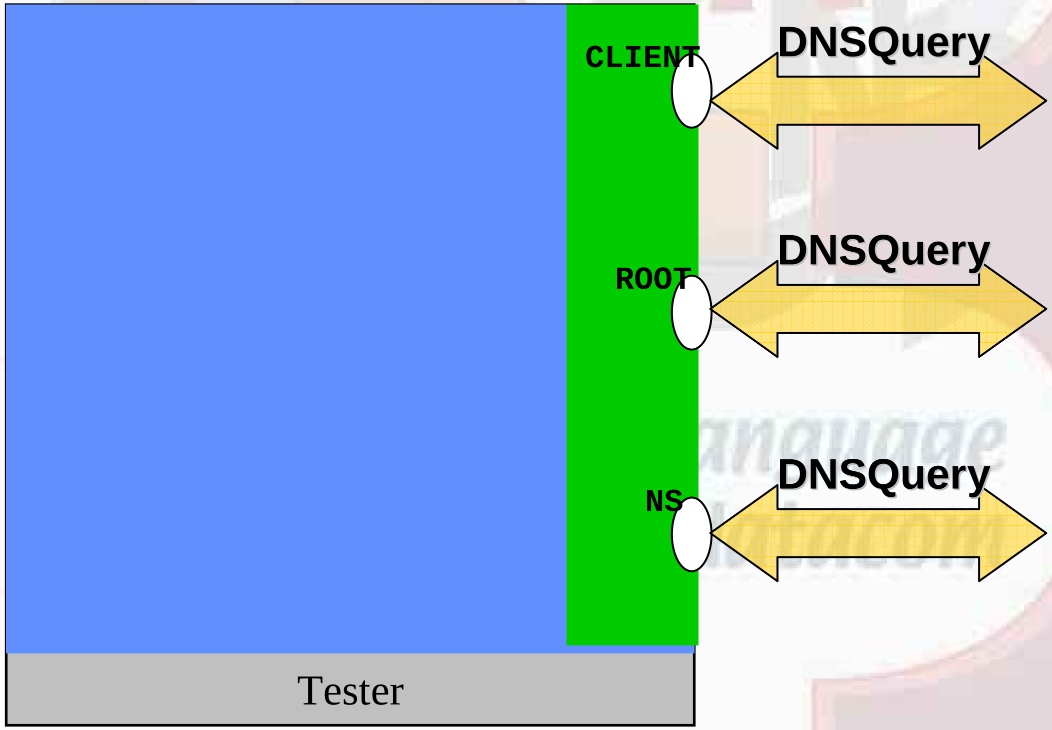


Tester
SUT
Tester
Client
DNS
root NS
NS
("www.nokia.com",A)
("nokia.com",NS)
("nokia.com","ns.nokia.com",NS)
("www.nokia.com",A)
("www.nokia.com",193.65.100.110,A)
("www.nokia.com",193.65.100.110,A)

Parallel Test Components

- Test system interface

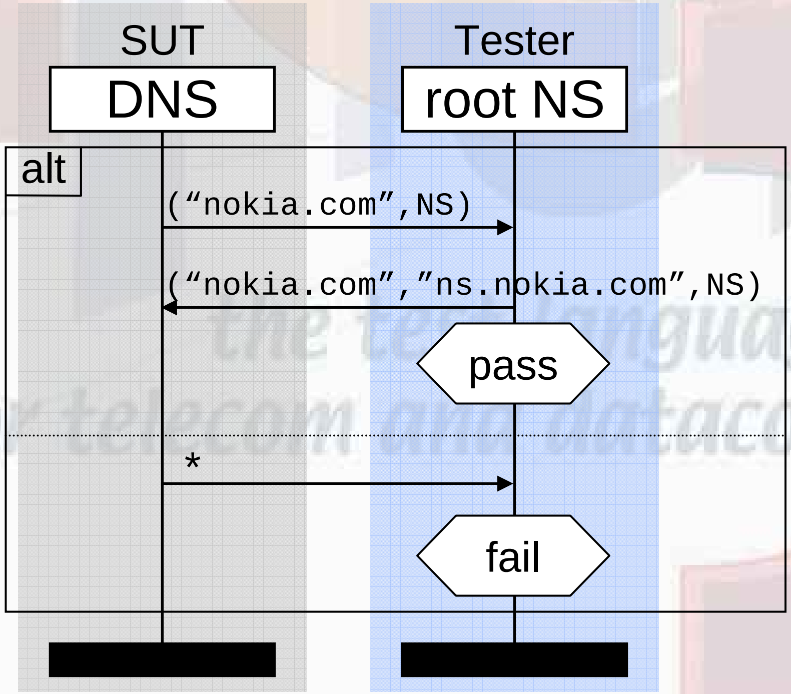
```
type component TSI {
       port DNSPort CLIENT,
       port DNSPort ROOT,
       port DNSPort NS
}
```



Parallel Test Components contd.

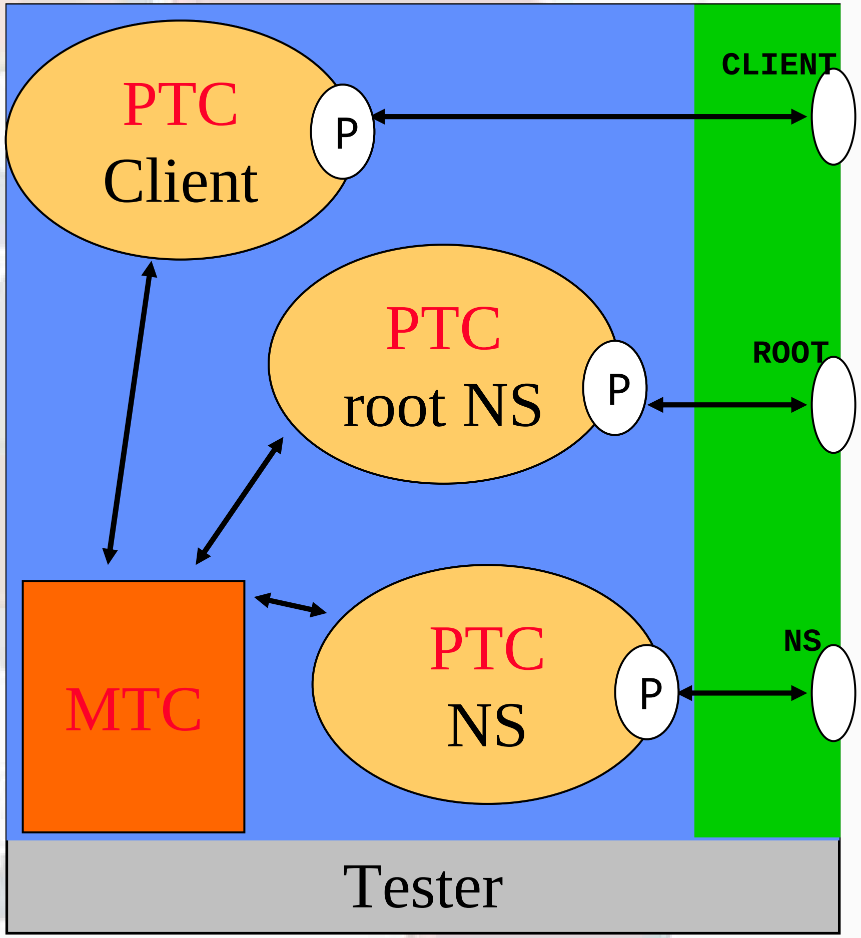
- TTCN-3 functions define the behavior of the parallel test components

```
function RootBehaviour() runs on DNSTester {
        alt {   [] P.receive(rootquery) {
                           P.send(rootanswer);
                           setverdict(pass);
                }
                [] P.receive {setverdict(fail);}
        }
        stop;
}
```



Dynamic Configuration

```
testcase Testcase3() runs on MTC
                     system TSI {

   var DNSTester RootComp, NSComp, ClientComp;

   RootComp   := DNSTester.create;
   NSComp     := DNSTester.create;
   ClientComp := DNSTester.create;

   map(RootComp:P,   system:ROOT);
   map(NSComp:P,     system:NS);
   map(ClientComp:P, system:CLIENT);

   RootComp.start  (RootBehaviour());
   NSComp.start    (NSBehaviour());
   ClientComp.start(ClientBehaviour());

   ClientComp.done;
   // block until ClientComp is done

   stop;
}
```



- Re-configuration during run time is possible

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Current Status

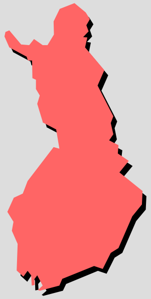
- A number of commercial TTCN-3 toolsets are available
- ETSI is already using TTCN-3 for the TIPHON SIP and IPv6
- TTCN-3 is already being used in SIP and IPV6 bake-off events
- Major telecoms companies are developing migration plans for moving from TTCN-2 to TTCN-3.
- European Projects to disseminate technology

TT-Medal Project

Project Goals:

- To develop the methodologies, tools and industrial experience to enable European industry to test more effectively and more efficiently
- To drive the deployment of TTCN-3 testing technology into European industry

TT-Medal Partners



CONFORMIQ

NetHawk

VTT

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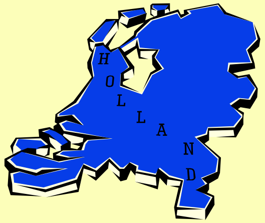
CONNECTING PEOPLE

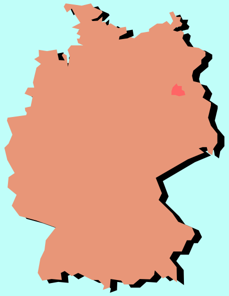


logicaCMG

CWI

IMPROVE
Quality Services

ProRail



DAIMLERCHRYSLER

<testing_tech>

FOKUS
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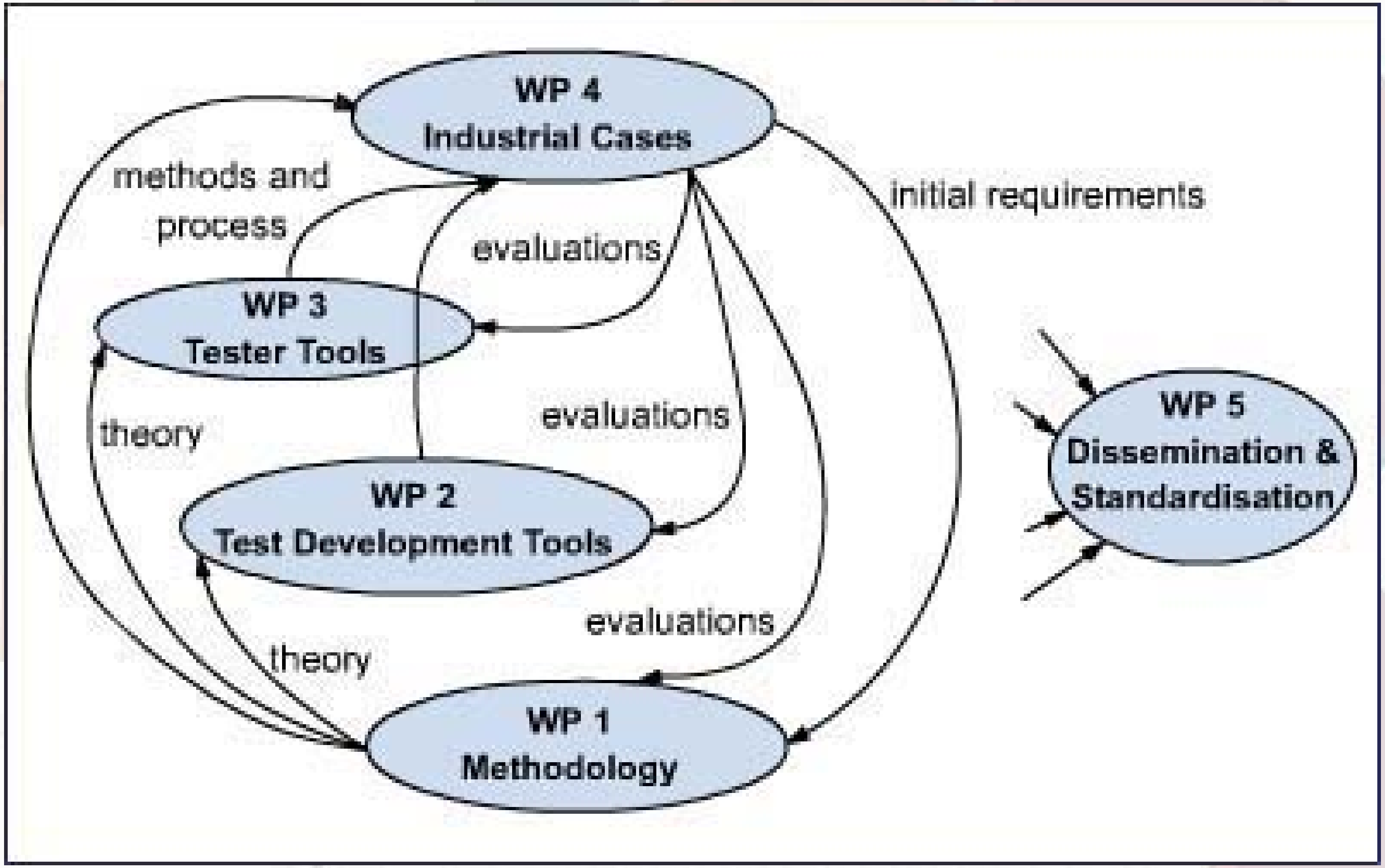
TT-Medal Results

- **TTCN-3 Asset Box** will provide all the tools for:
  - generic testing processes,
  - systematic test development and testing methodology,
  - reuse,
  - architecture,
  - new application domains,
  - tool prototypes,
  - UML 2.0 testing profile,
  - test validation, and
  - lightweight testing process & tools

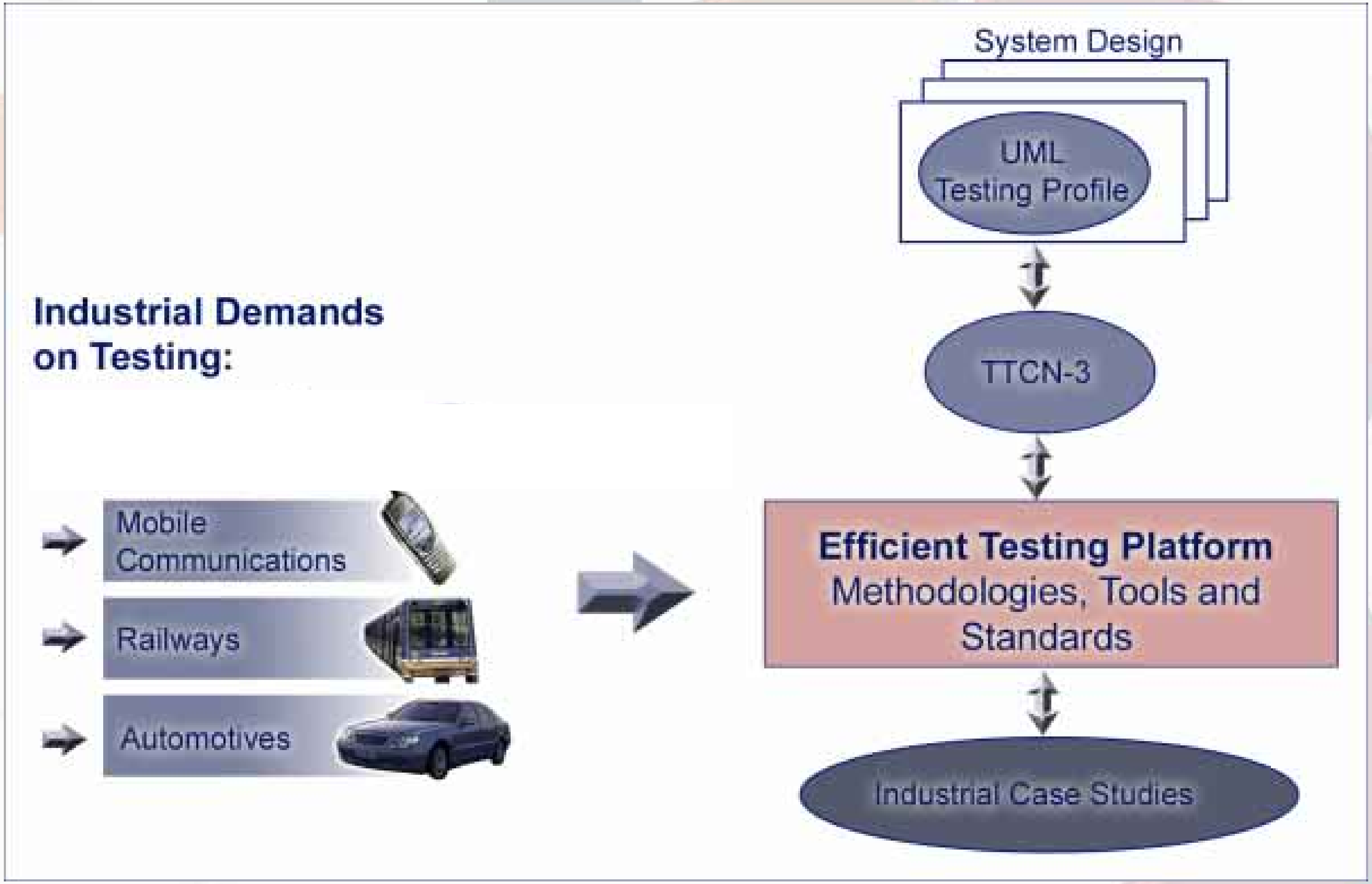
TT-Medal Results

- **Training package:** to show *how* the new technologies should be used, help project partners and others in European industry with effective testing in their business processes.
- **Experience package:** to show *where* these new technologies should be applied and *why*, will provide the means for sharing data on adequate tools, testing methods, applicability of processes, available test cases, and conformance specification, how to obtain sufficient testing resources (from management) and how to leverage these.

TT-Medal Structure



TT-Medal Application Areas

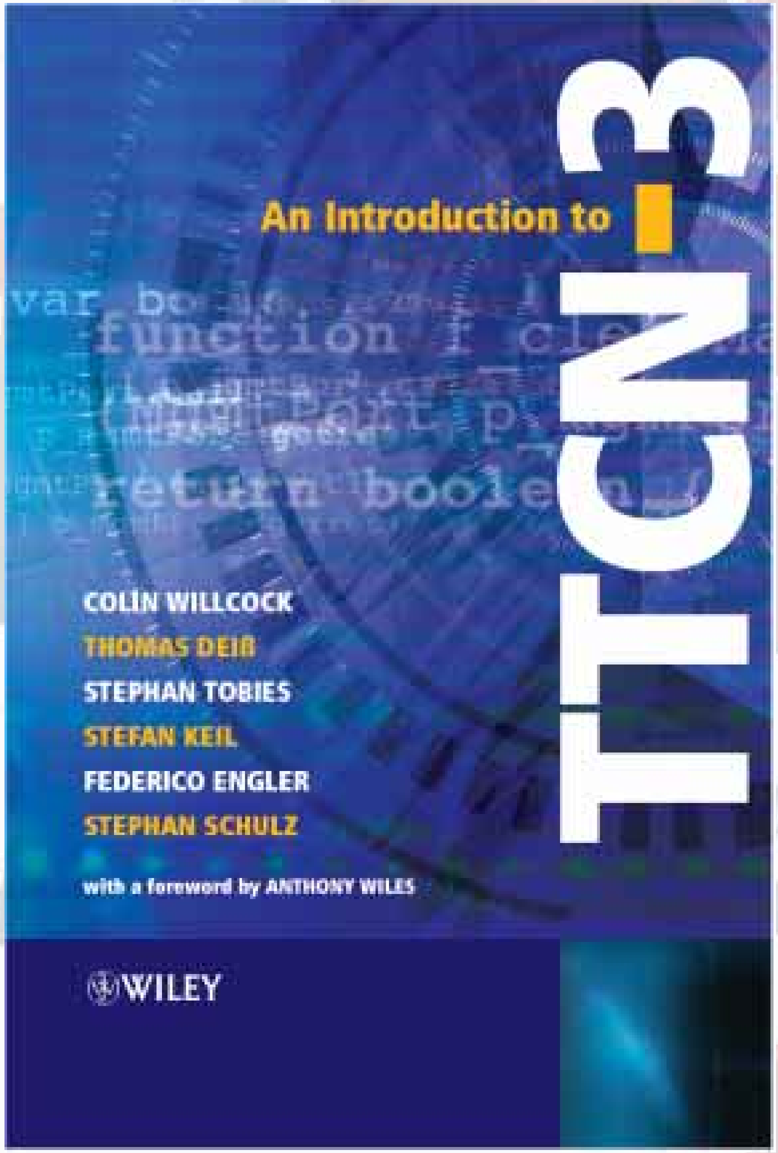


Industrial Demands on Testing:

TTCN-3 Outlook

- Short term:
  - Replacing TTCN-2 in functional and conformance testing as standard language.
  - Increasing use within the IP world especially for text based protocols
  - Possible key technology in the IP/telecom convergence.
- Medium term:
  - Expanding from pure protocol testing to software testing and interworking testing.
  - Possible key technology for unifying testing technology across whole product development.
- Long term:
  - Real time and performance testing? (European INTERVAL project)
  - Integration with UML (UML testing profile)

More Information?



An Introduction to TTCN-3

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with a foreword by ANTHONY WILES

WILEY

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AND THEN I USED TTCN-3
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