



# Automated Interoperability Testing with TTCN-3

How to increase efficiency

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# Outline

- ❑ **Motivation**
  - Interoperability testing – Who and Why
- ❑ **How to increase the efficiency of interoperability testing**
  - Where is the money spend
  - How can we spend the money more efficiently
- ❑ **Conclusion**

## Different Types of Testing

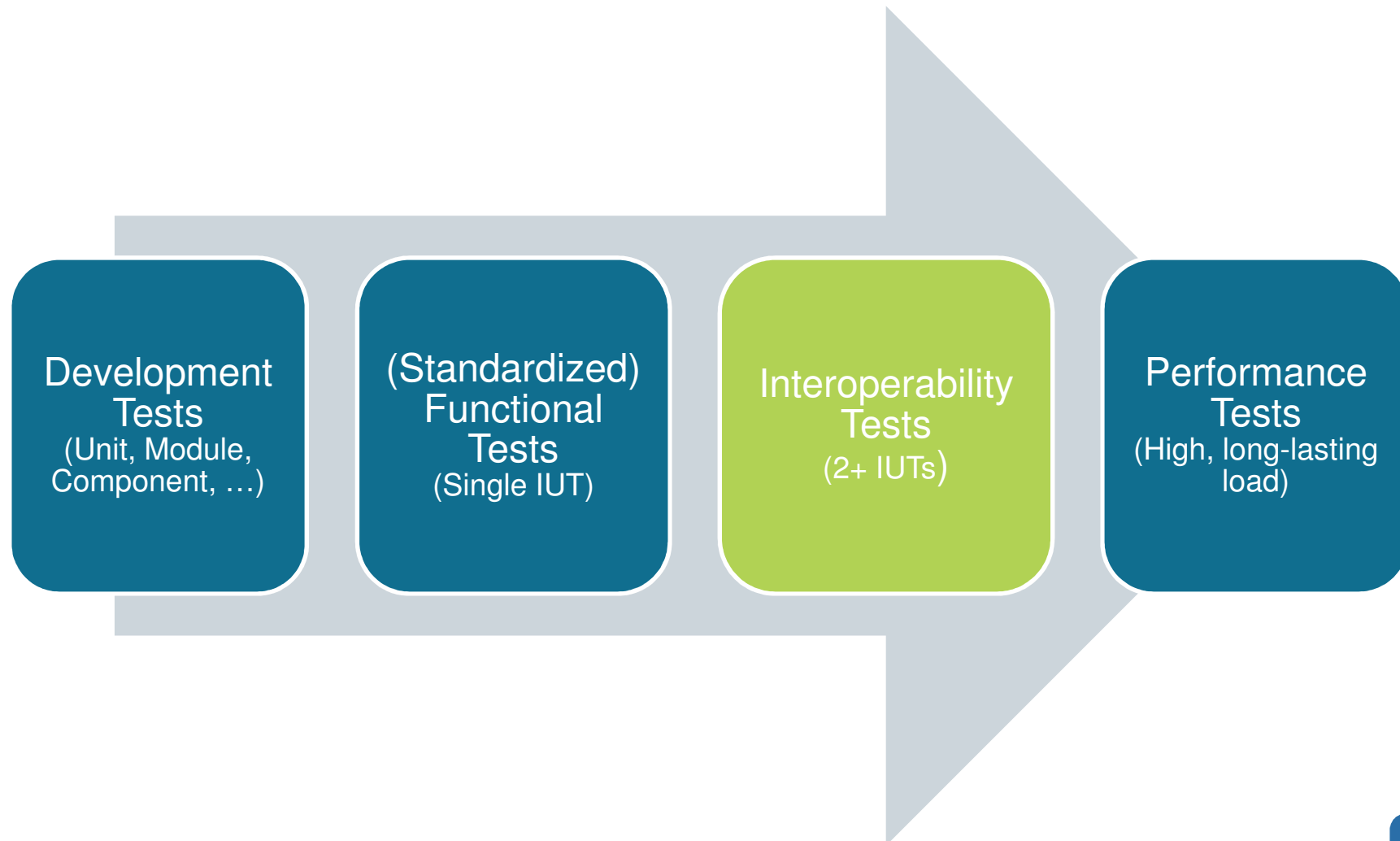
Development  
Tests  
(Unit, Module,  
Component, ...)

(Standardized)  
Functional  
Tests  
(Single IUT)

Interoperability  
Tests  
(2+ IUTs)

Performance  
Tests  
(High, long-lasting  
load)

## Different Types of Testing



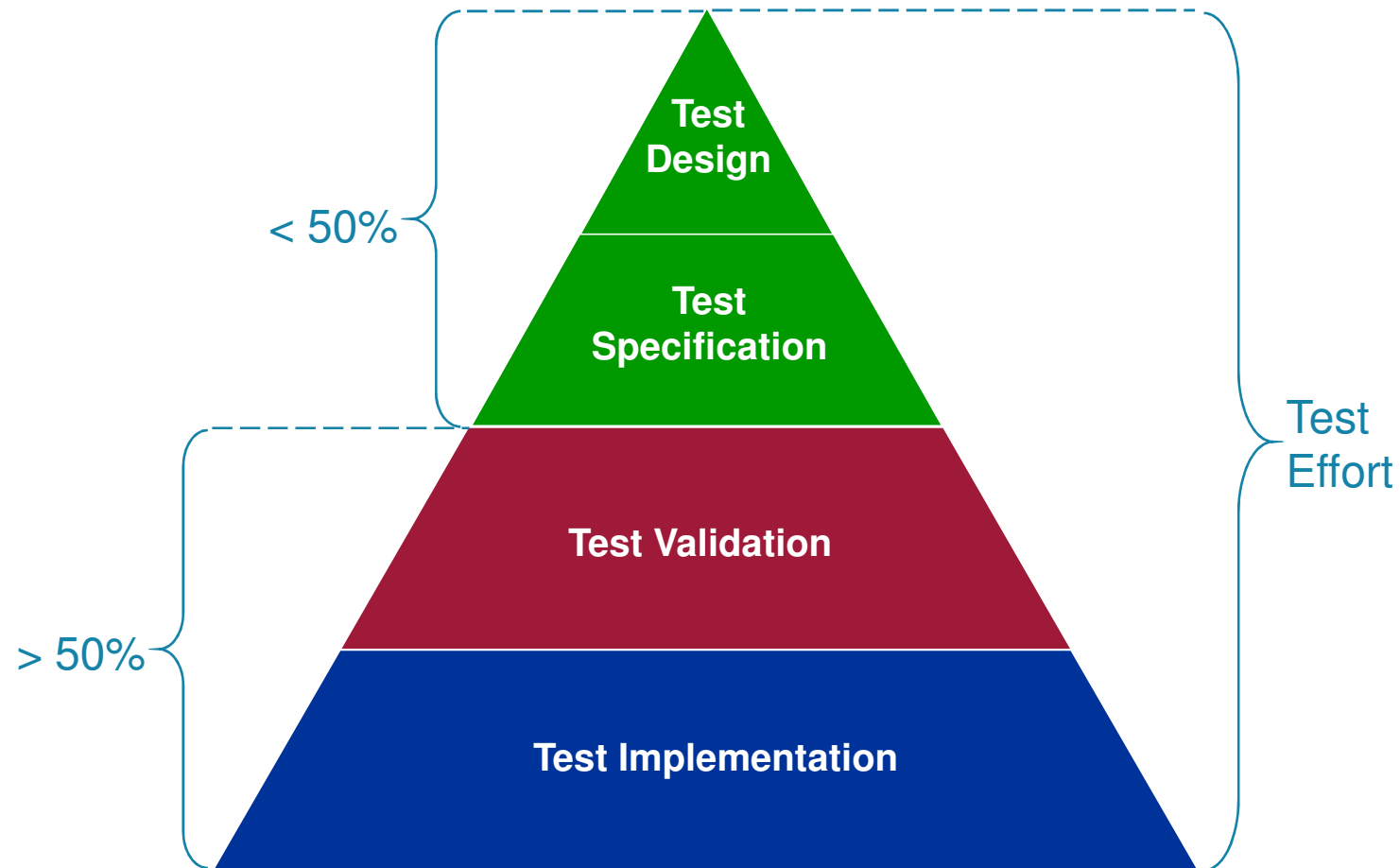
## Rise of Interoperability Testing

- ❑ **Classical conformance testing is becoming too costly**
  - **New approach which checks conformance as part of interoperability testing is showing promising results**
  - **Does not guarantee interoperability of tested products**
- ❑ **Bi-lateral testing and interoperability events are increasingly accepted as a solution to improve interoperability**
  - **ETSI - interoperability test specifications & Plugtests<sup>TM</sup> for a wide range of technologies including IMS, HDMI, IP, VoIP, RFID, grid, etc**
  - **OMA - interoperability test specifications & Testfests for enablers**
  - **WiMax – network infrastructure interoperability testbed**
  - **Over 700.000 hits with Google, more than 1,3 million hits with Yahoo**

## Interoperability Testing Today

- ❑ **Interoperability testing means different things to different people**
  - **Attend an event**
  - **Test whatever with whoever whenever you want (ad-hoc)**
  - **Scheduled test sessions (attempting to cover all possible pairings of different participating products)**
  - **Execution of agreed test list in each test session**
  - **Validation of execution traces against standards**
  - **As well as various combinations of the above**
- ❑ **Majority of interoperability testing and validation is performed manually**
  - **Labor intensive**
  - **Does not scale**
  - **Error prone**
  - **Frequently inconsistent**

## Break-Down of Test Effort today



## Test Effort spent at ETSI 1<sup>st</sup> IMS Plugtest 2007

### □ Background information

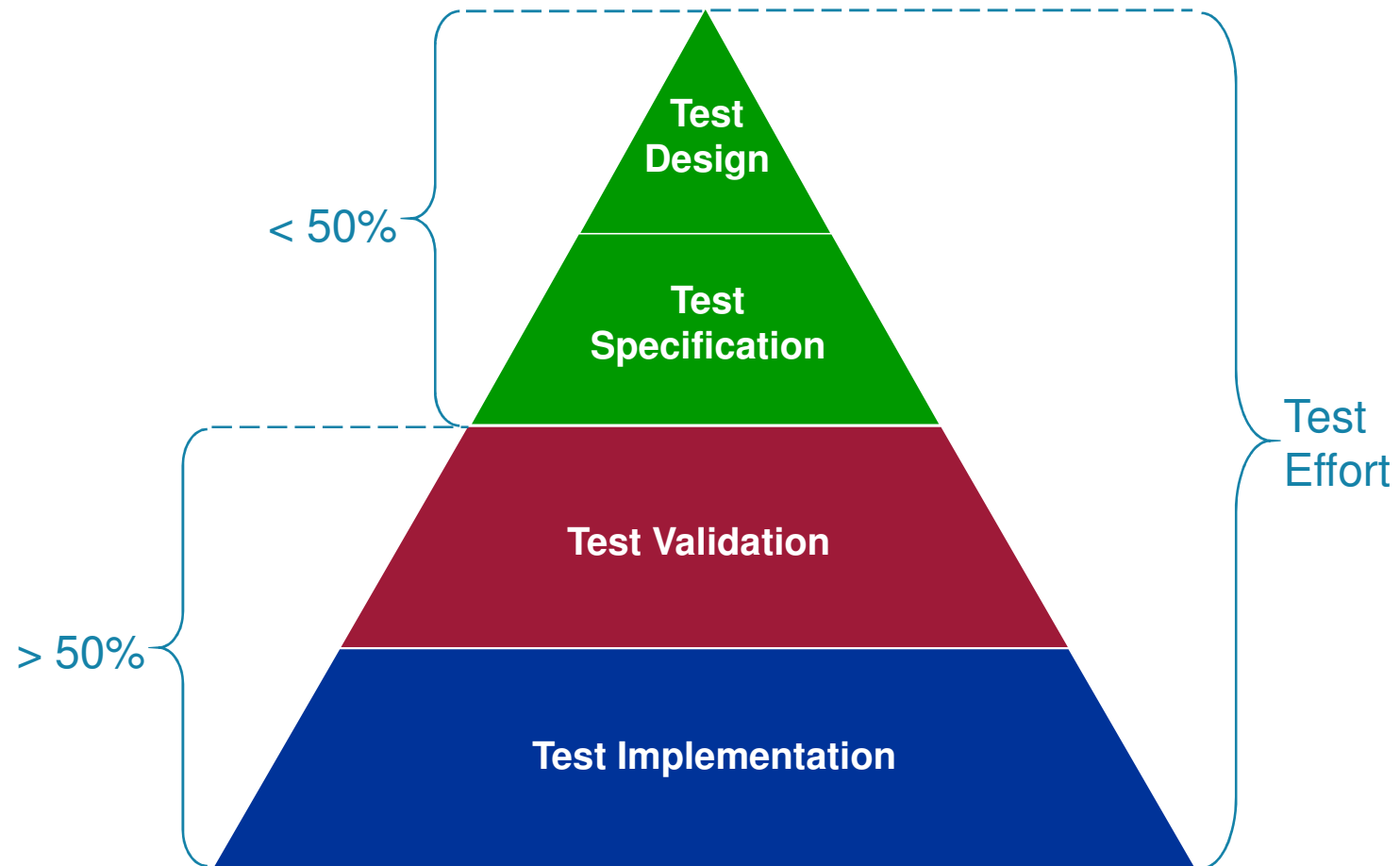
- Event assessing IMS core network interoperability at network-to-network (NNI) interface
- Agreed test list with 23 different interoperability tests
- 6 IMS core networks tested all against each other
- 30 recorded test sessions (A -> B as well as B -> A)
- 482 test execution traces to be evaluated (SIP message flows)
- 4 days time for test execution, recording, and evaluation

### □ The testing effort

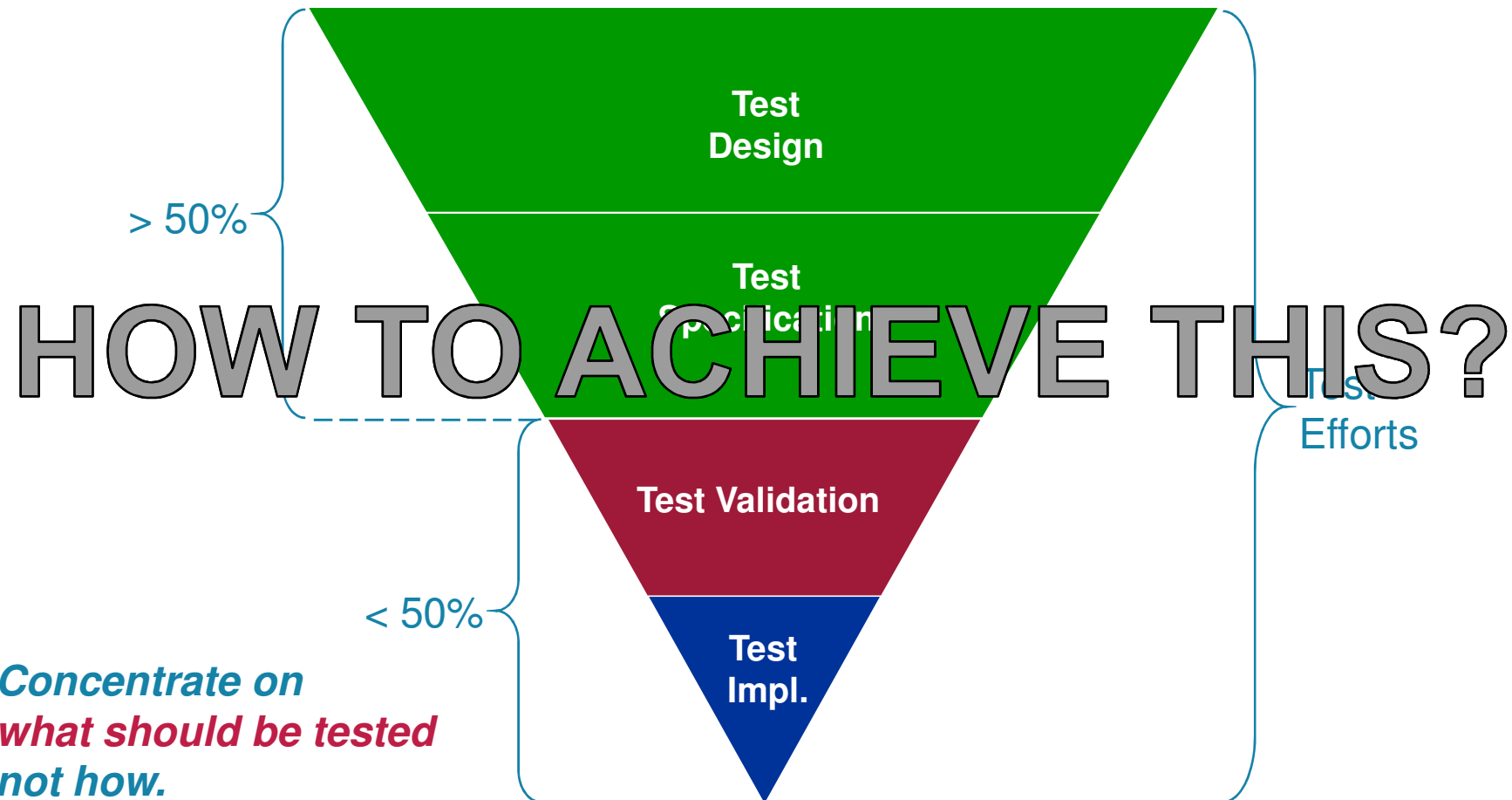
- 180 h of interoperability testing (46%)
- 204 h of manual validation of execution traces (54%)
- Sums up to total effort of 384 h (100%) related to testing
  - 48 pd



## Break-Down of Test Effort today



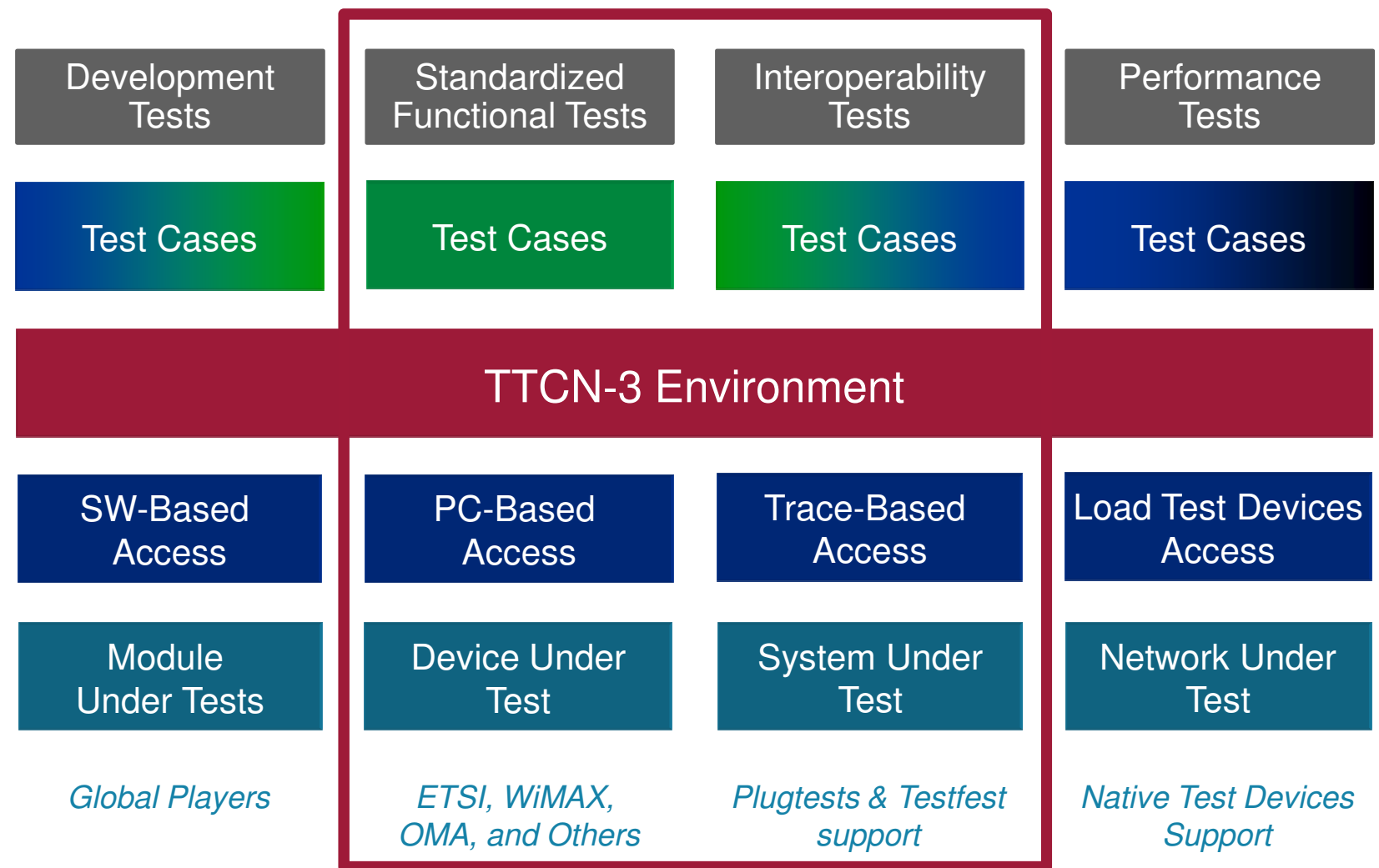
## Desired Break-down of Test Effort



## Reuse: key for increasing efficiency

- ❑ Reuse of test code across different types of testing
- ❑ Reuse of information between
  - System architects
  - Developers
  - Testers
  - Managers
- ❑ Reuse of test system artifacts
- ❑ Reuse of know-how
  
- Use TTCN-3 as a common test language during different phases!

# How to Profit from TTCN-3



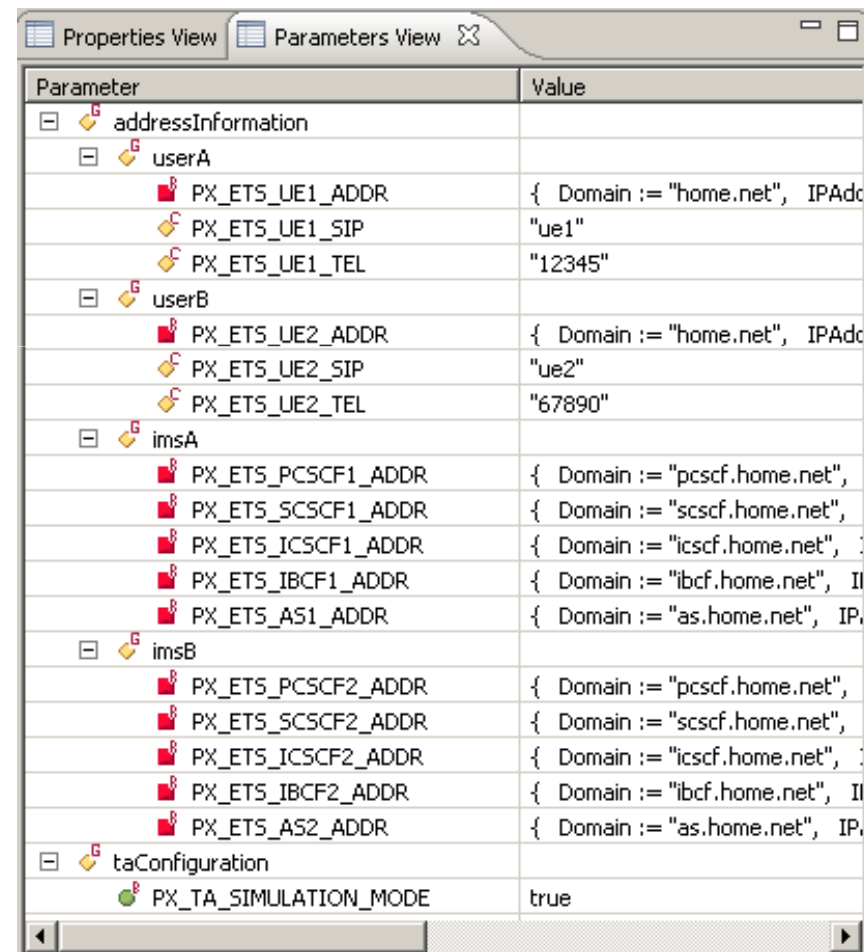
## Recommendations to increase testing efficiency

- ❑ Automate the interoperability trace checking with TTCN-3
  - Reduces cost+time & increases consistency of results!
- ❑ Reuse constructs from existing test frameworks
  - Profit from investments already made
- ❑ Use industrial grade test automation tools
  - Benefit from well accepted processes, workflows and tools

***A TTCN-3 allows to minimize validation effort for interoperability testing!***

## One example implementation – TT trace player

- ❑ Uses files to configure IP information of equipment monitored in test session
- ❑ Import of PCAP trace and validation integrated in TTCN-3 tool
- ❑ Implements test system for standardized IMS interoperability trace checking tests
- ❑ Successfully used for trace analysis in 2<sup>nd</sup> ETSI IMS Plugtests 2008



Parameter	Value
addressInformation	
userA	
PX_ETS_UE1_ADDR	{ Domain := "home.net", IPAdc
PX_ETS_UE1_SIP	"ue1"
PX_ETS_UE1_TEL	"12345"
userB	
PX_ETS_UE2_ADDR	{ Domain := "home.net", IPAdc
PX_ETS_UE2_SIP	"ue2"
PX_ETS_UE2_TEL	"67890"
imsA	
PX_ETS_PCSCF1_ADDR	{ Domain := "pcscf.home.net",
PX_ETS_SCSCF1_ADDR	{ Domain := "scscf.home.net",
PX_ETS_ICSCF1_ADDR	{ Domain := "icscf.home.net", :
PX_ETS_IBCF1_ADDR	{ Domain := "ibcf.home.net", II
PX_ETS_AS1_ADDR	{ Domain := "as.home.net", IP.
imsB	
PX_ETS_PCSCF2_ADDR	{ Domain := "pcscf.home.net",
PX_ETS_SCSCF2_ADDR	{ Domain := "scscf.home.net",
PX_ETS_ICSCF2_ADDR	{ Domain := "icscf.home.net", :
PX_ETS_IBCF2_ADDR	{ Domain := "ibcf.home.net", II
PX_ETS_AS2_ADDR	{ Domain := "as.home.net", IP.
taConfiguration	
PX_TA_SIMULATION_MODE	true

# Example trace checking test execution log

**TTCN-3 Execution Management - IMS\_NNI\_Interworking/traceplay.config - TTworkbench Professional**

File Edit Navigate Search Project Run Window Help

Management View Meta Campaign View Console Dump View Test Data View

1225902415437

Case	Runs	INCONC/FAIL Action	Retries	Module
TC_IMS_003	1	CONTINUE	0	IMS_Testcases

17:26:55.437  
17:31:51.015

**Expected TTCN-3 Template**

Name	Value
event	*
subscriptionState	*
pMediaAuthorization	*
pAssertedId	*
fieldName	P_ASSERTED
nameAddr	*
[0]	*
displayName	*
addrSpec	*
scheme	sip
userInfo	?
hostPort	?
urlParameters	*
headers	*
[1]	*
displayName	?

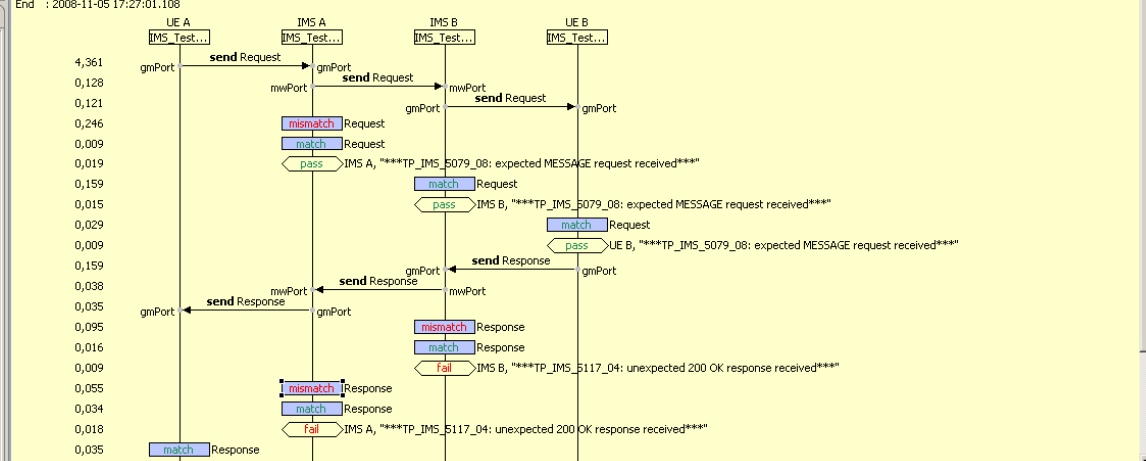
**Data**

Name	Value
event	omit
subscriptionSt	omit
pMediaAuthori	omit
pAssertedId	omit
fieldName	P_ASSERTED_ID_E
nameAddr	*
[0]	*
dis	omit
ad	omit
sip	omit
user_2_pub	omit
omit	omit
yyyyyyyyy.net	omit
omit	omit
nmit	omit

Time:

**TTCN-3 Graphical Logging**

IMS\_Testcases.TC\_IMS\_003 <component filter active>  
Start : 2008-11-05 17:26:55.488  
End : 2008-11-05 17:27:01.108



4,361 gmPort send Request  
0,128 mwPort send Request  
0,121 gmPort send Request  
0,246 mwPort send Request  
0,009 gmPort send Request  
0,019 gmPort send Request  
0,159 gmPort send Request  
0,015 gmPort send Request  
0,029 gmPort send Request  
0,009 gmPort send Request  
0,159 gmPort send Request  
0,038 gmPort send Request  
0,035 gmPort send Request  
0,095 gmPort send Request  
0,016 gmPort send Request  
0,009 gmPort send Request  
0,055 gmPort send Request  
0,034 gmPort send Request  
0,018 gmPort send Request  
0,035 gmPort send Request  
0,012 gmPort send Request

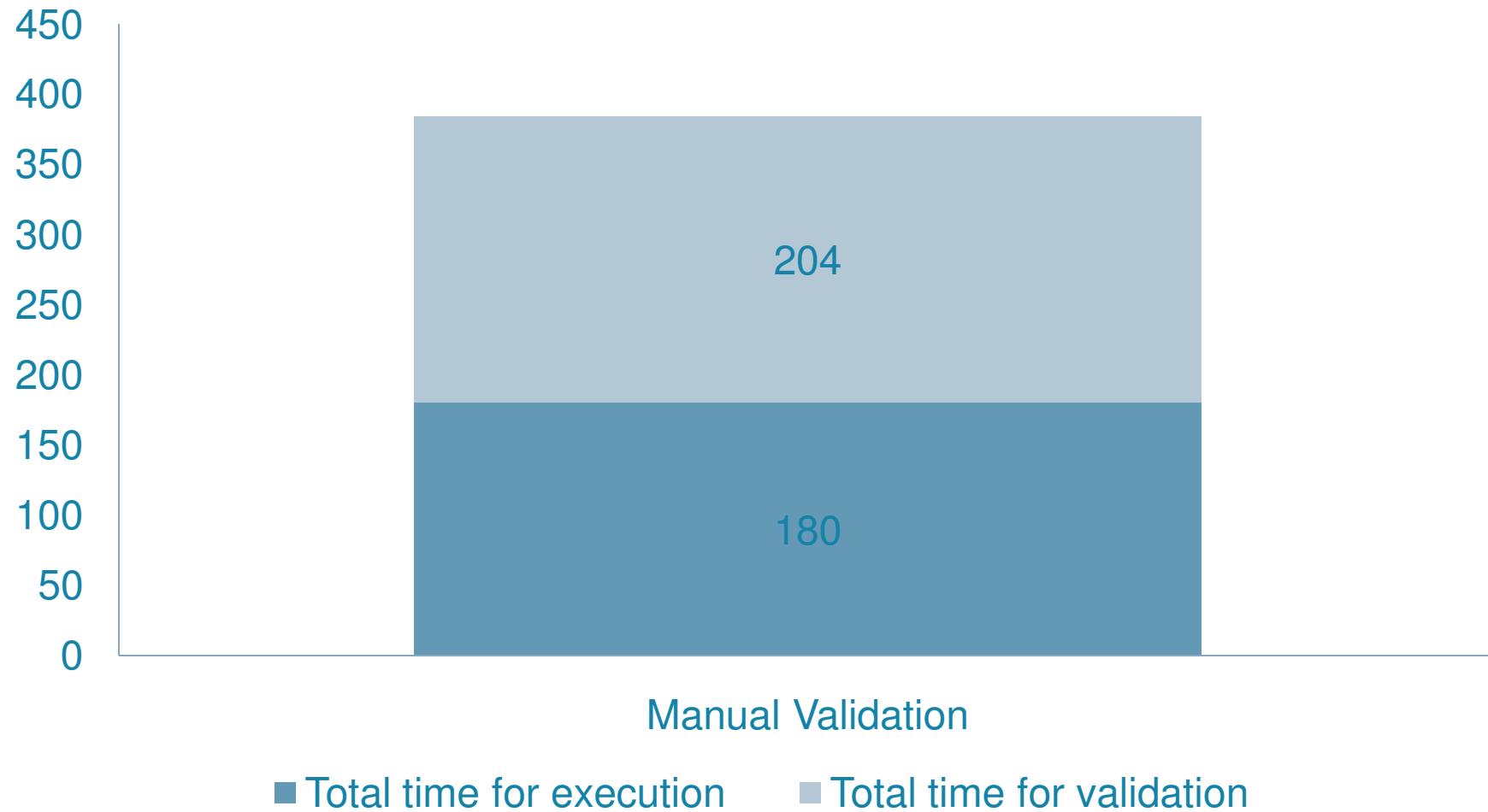
0,128 gmPort send Response  
0,095 gmPort send Response  
0,016 gmPort send Response  
0,009 gmPort send Response  
0,055 gmPort send Response  
0,034 gmPort send Response  
0,018 gmPort send Response  
0,035 gmPort send Response  
0,012 gmPort send Response

0,121 gmPort mismatch Request  
0,121 gmPort match Request  
0,121 gmPort pass IMS A, \*\*\*\*TP\_IMS\_5079\_08: expected MESSAGE request received\*\*\*\*  
0,121 gmPort match Request  
0,121 gmPort pass IMS B, \*\*\*\*TP\_IMS\_5079\_08: expected MESSAGE request received\*\*\*\*  
0,121 gmPort match Request  
0,121 gmPort pass UE B, \*\*\*\*TP\_IMS\_5079\_08: expected MESSAGE request received\*\*\*\*  
0,121 gmPort mismatch Response  
0,121 gmPort match Response  
0,121 gmPort fail IMS B, \*\*\*\*TP\_IMS\_5117\_04: unexpected 200 OK response received\*\*\*\*  
0,121 gmPort mismatch Response  
0,121 gmPort match Response  
0,121 gmPort fail IMS A, \*\*\*\*TP\_IMS\_5117\_04: unexpected 200 OK response received\*\*\*\*  
0,121 gmPort mismatch Response  
0,121 gmPort match Response  
0,121 gmPort fail UE A, \*\*\*\*TP\_IMS\_5117\_04: unexpected 200 OK response received\*\*\*\*

**Properties View**

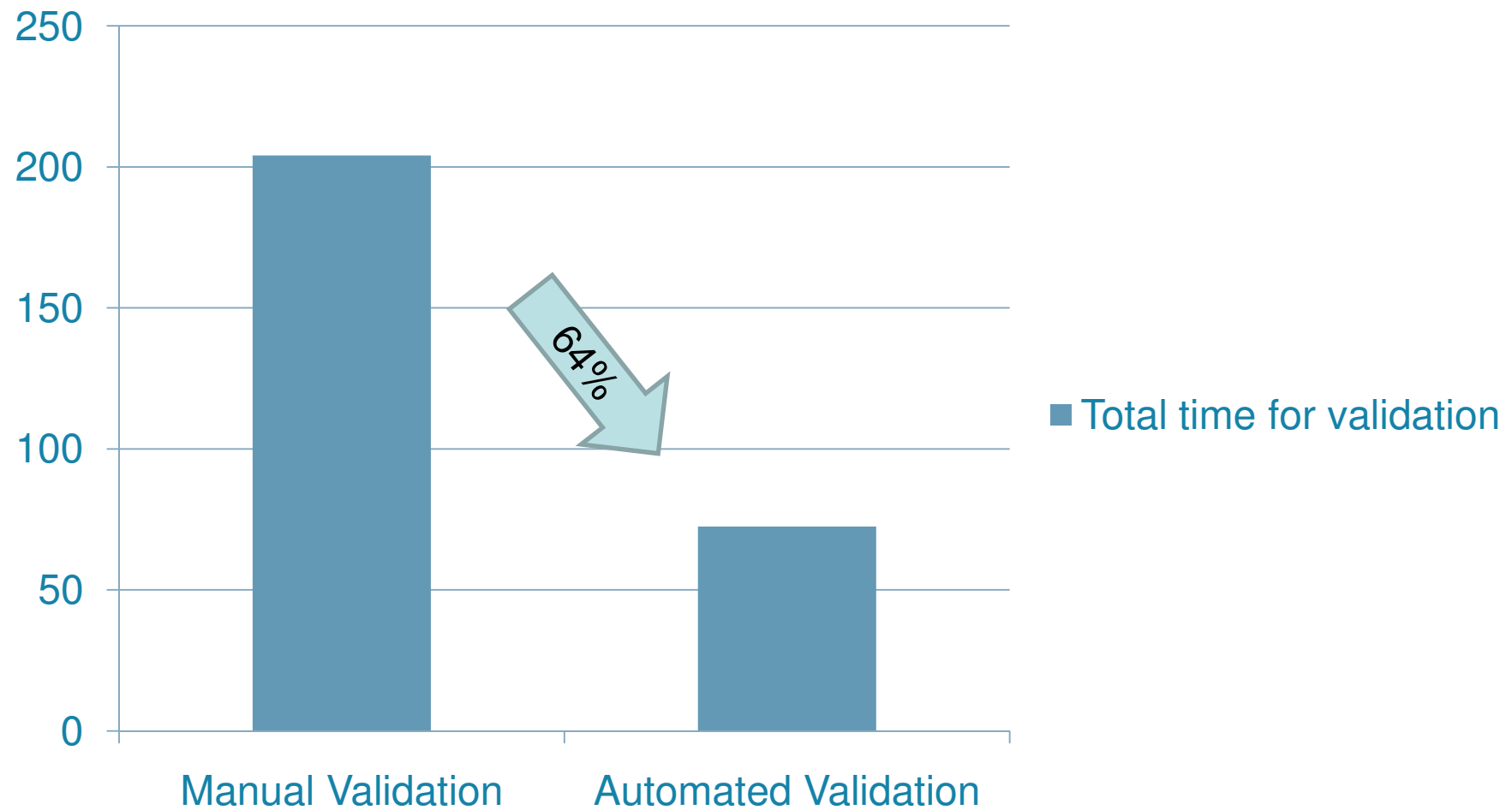
Parameter	Value
addressInformation	
userA	
PX_ETS_UE1_ADDR	{ Domain := "home.net", IPAddress := "163.162.161.53"
PX_ETS_UE1_SIP	"ue1"
PX_ETS_UE1_TEL	"12345"
userB	
PX_ETS_UE2_ADDR	{ Domain := "home.net", IPAddress := "163.162.1.65",
PX_ETS_UE2_SIP	"ue2"
PX_ETS_UE2_TEL	"67890"
imsA	
PX_ETS_PCSCF1_ADDR	{ Domain := "pcscf.home.net", IPAddress := "163.162.16
PX_ETS_SCSCF1_ADDR	{ Domain := "scscf.home.net", IPAddress := "163.162.16
PX_ETS_ICSCF1_ADDR	{ Domain := "icscf.home.net", IPAddress := "127.0.0.1",
PX_ETS_IBCF1_ADDR	{ Domain := "ibcf.home.net", IPAddress := "127.0.0.1",
PX_ETS_AS1_ADDR	{ Domain := "as.home.net", IPAddress := "127.0.0.1",
imsB	
PX_ETS_PCSCF2_ADDR	{ Domain := "pcscf.home.net", IPAddress := "192.168.1.
PX_ETS_SCSCF2_ADDR	{ Domain := "scscf.home.net", IPAddress := "163.162.1.
PX_ETS_ICSCF2_ADDR	{ Domain := "icscf.home.net", IPAddress := "127.0.0.1",
PX_ETS_IBCF2_ADDR	{ Domain := "ibcf.home.net", IPAddress := "127.0.0.1",
PX_ETS_AS2_ADDR	{ Domain := "as.home.net", IPAddress := "127.0.0.1",
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PX_TA_SIMULATION_MODE	true

## What did we gain?

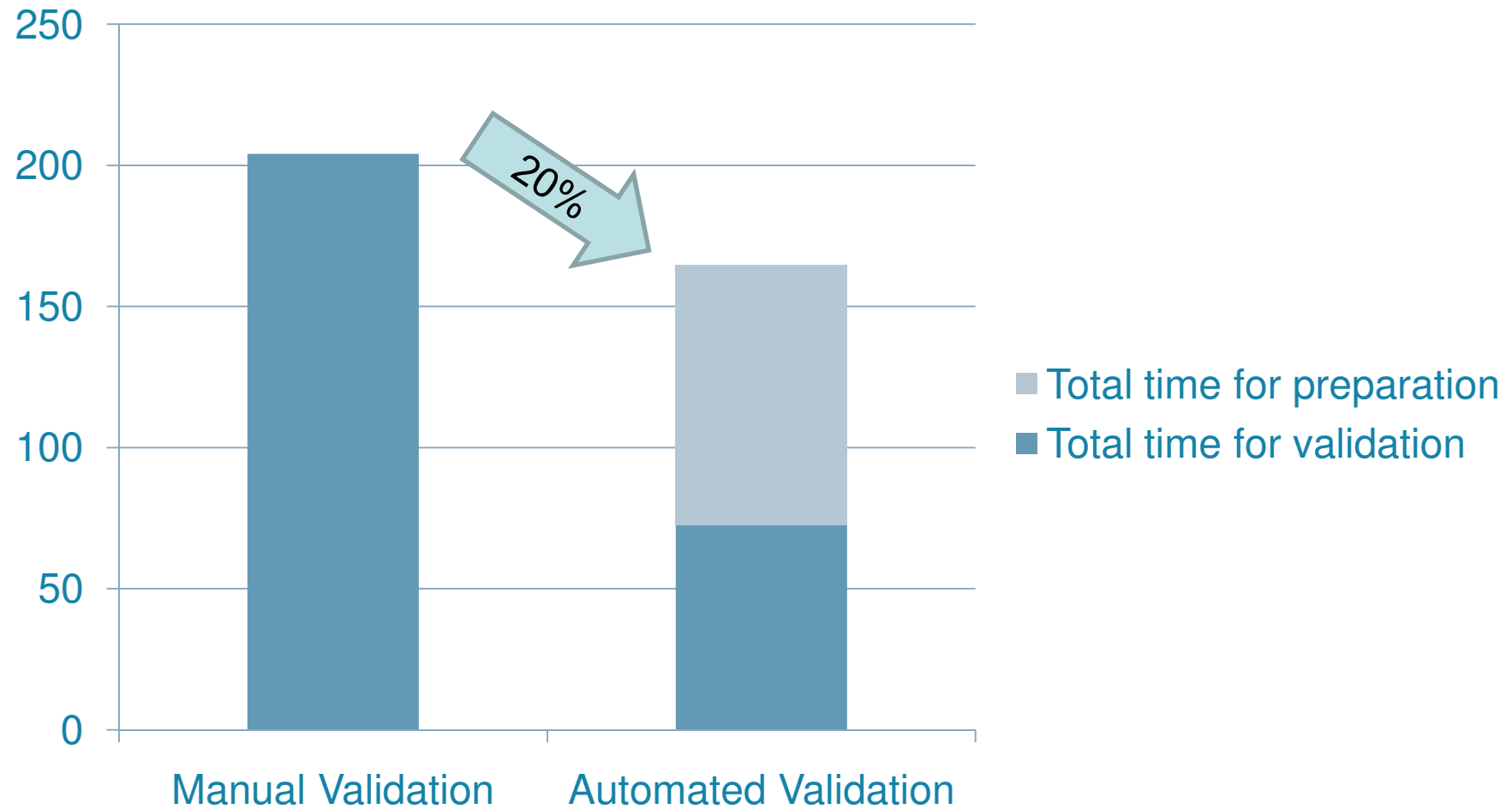




## What did we gain?



## What did we gain?



## STF 370 – Automating interoperability testing

- ❑ ETSI STF investigating use of TTCN-3 for automating interoperability testing of distributed systems
  - Case study selected to be IMS core network testing
  - Funded in part by European Commission
  - Builds on results from TTCN-3 tool development for 2<sup>nd</sup> IMS Plugtest
  - Started in 2009 and expected to finish in 2010
- ❑ Output includes
  - ETSI guide on a methodology for automated IOT
  - ETSI technical specification on application of it to IMS domain
  - TTCN-3 tests implementing standardized ETSI IMS interoperability test descriptions
  - TTCN-3 codec and adapter implementations for a test system
  - Validation and report for using TTCN-3 tool in upcoming IMS Plugtest
  - White paper on STF experiences & lessons learned

## Conclusions

- ❑ Interoperability testing is an accepted way to reduce interoperability problems
- ❑ Manual interoperability testing is time consuming and error prone and therefore expensive
- ❑ Automation of interoperability trace checking can reduce the costs up to 50% as compared to manual validation
  - Standardized test framework
  - Off-the-shelf TTCN compilers
- ❑ Standards, tools and the people are available today

## Road ahead

- ❑ Reduce cost even more by further optimizing the TTCN-3 test design for interoperability trace checking
  - Based on feedback from first use at 2<sup>nd</sup> IMS Plugtest
  - Note that previous test system was build in only 10 days!
- ❑ Align existing test framework with new ETSI automated methodology
- ❑ Next application of this is at 3<sup>rd</sup> ETSI IMS Plugtest in Lannion FR
  - [www.etsi.org/plugtests/IMS IPTV](http://www.etsi.org/plugtests/IMS_IPTV)
- ❑ Apply these concepts also in other domains
  - Grid
  - WiMax
  - HL7 (eHealth)



THANK YOU!

Questions?