CONNECTED VEHICLE CERTIFICATION

TEST SYSTEMS OVERVIEW

Nov 15, 2016

GOALS / SCOPE

d Vehicle test

ns

USDOT CERTIFICATION PROGRAM

- The USDOT competitively selected three certification service providers (7Layers, Danlaw, and Southwest Research Institute (OmniAir))
- All three work together through the Certification Operating Council (COC) to support certification testing for CV Pilots
- Vision is to help the industry to organize and run a self-sustaining certification program supporting deployment of DSRC-based services.

Danlaw provides connected vehicle telematics solutions and embedded electronics to OEMs and their Tier-1 supply chain.

OmniAir Cerfication Services (OCS) is a non-profit organization founded by OmniAir to execute independent certification for the intelligent transportation industry.

7Layers is an international group of engineering & test centers having a core competence in wireless technologies.

DSRC TECHNOLOGY & OPEN STANDARDS

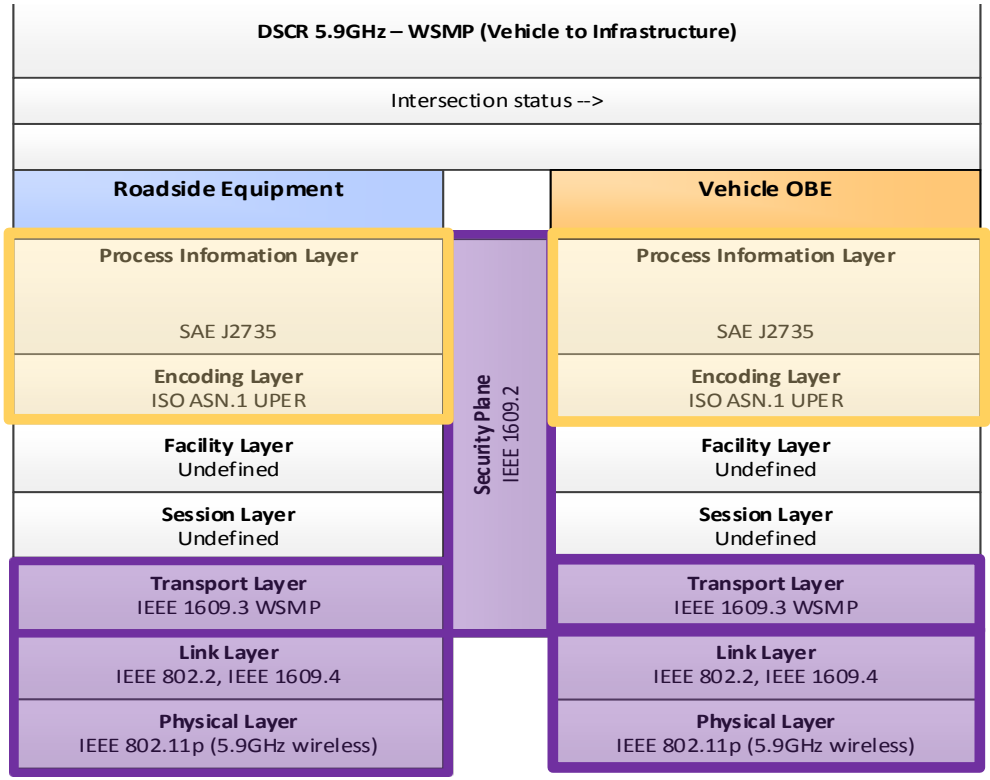
Dedicated Short Range Communication is a wireless communication technology similar to Wi-Fi optimized for vehicle-to-vehicle/infrastructure (V2X) communications

Data Messages

- SAE J2945/1 Requirements for BSM
- Process Information (SAEJ2735)
- Encoding (ISO ASN.1 UPER)

Data Transmission

- Transport (IEEE1609.3 WSMP, IPv6)
- Security (IEEE 1609.2)
- Link (IEEE 1609.4)
- Physical (IEEE 802.11)



TEST SPECIFICATIONS FOR CERTIFICATION

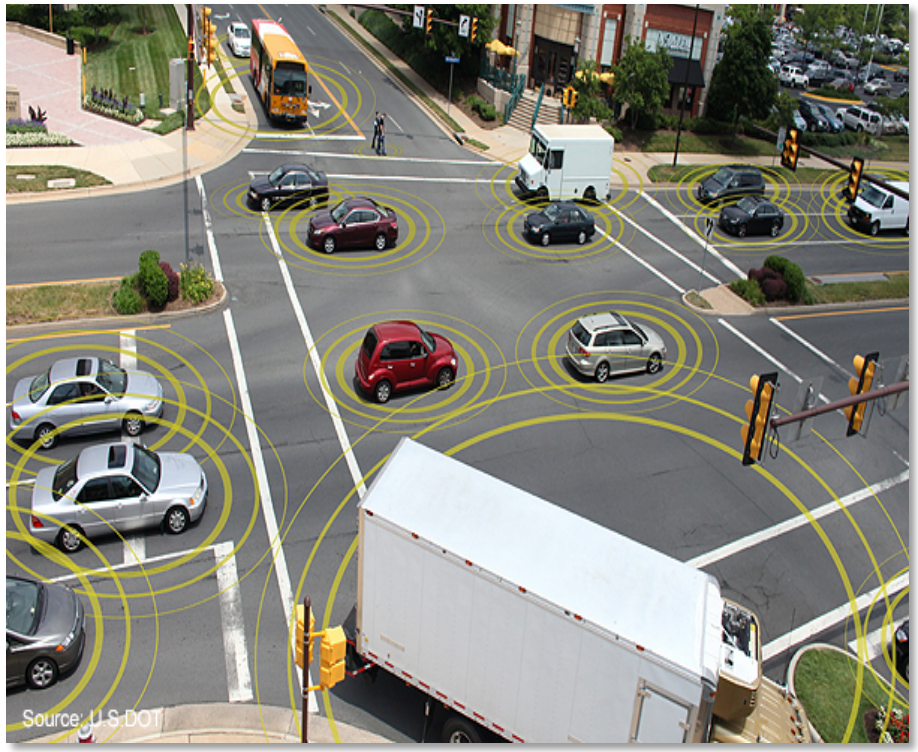
V2X Test Specifications supporting device certification

Test Specifications	Title / Scope	
WAVE802.11-TSS&TP	Test Suite Structure and Test Purposes for IEEE 802.11 (scope of DSRC)	
WAVEMCO-TSS&TP	Test Suite Structure and Test Purposes for Multi Channel Operation (IEEE 1609.4)	
WAVENS-TSS&TP	Test Suite Structure and Test Purposes for Network Services (IEEE 1609.3)	
WAVESEC-TSS&TP	Test Suite Structure and Test Purposes for Security Services (IEEE 1609.2)	
J2945.1-TSS&TP	Test Suite Structure and Test Purposes for J2945.1	
Test System Interface	Test Command Interface protocol specification	Available on http://www.github.com

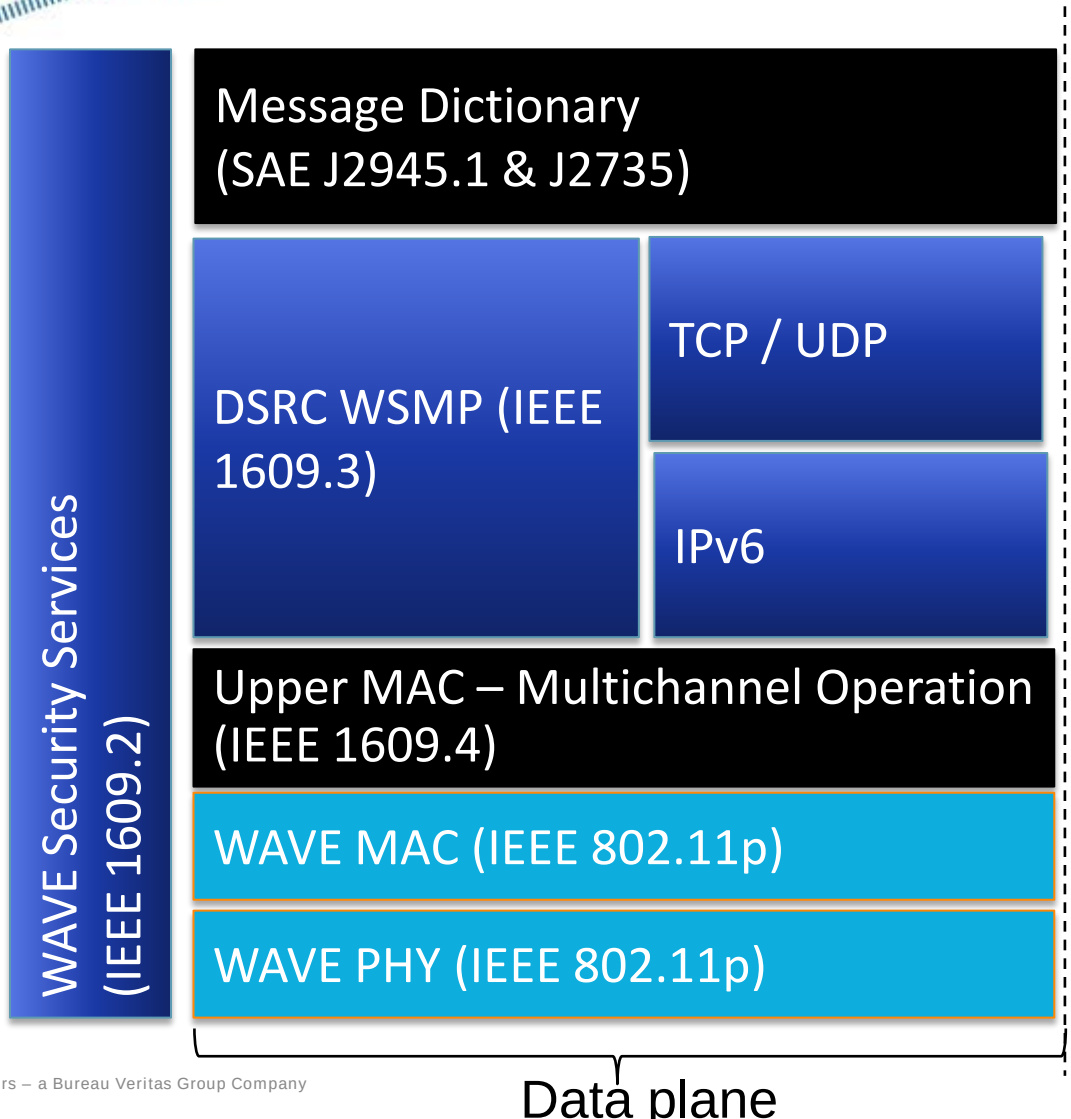
TEST SPECIFICATION OVERVIEW

- Total test cases developed 126: as follows:
  - SAE J2735 – 41 Test Cases
  - IEEE 1609.4 – 10 Test Cases
  - IEEE 1609.3 – 34 Test Cases
  - IEEE 1609.2 – 21 Test Cases
  - IEEE 802.11- 2012 – 20 Test Cases

- Summary
  - Positive/negative behavior testing
  - Protocol, message format and parameter testing
  - Radio performance in transmit and receive mode



COC DSRC CERTIFICATION COVERAGE



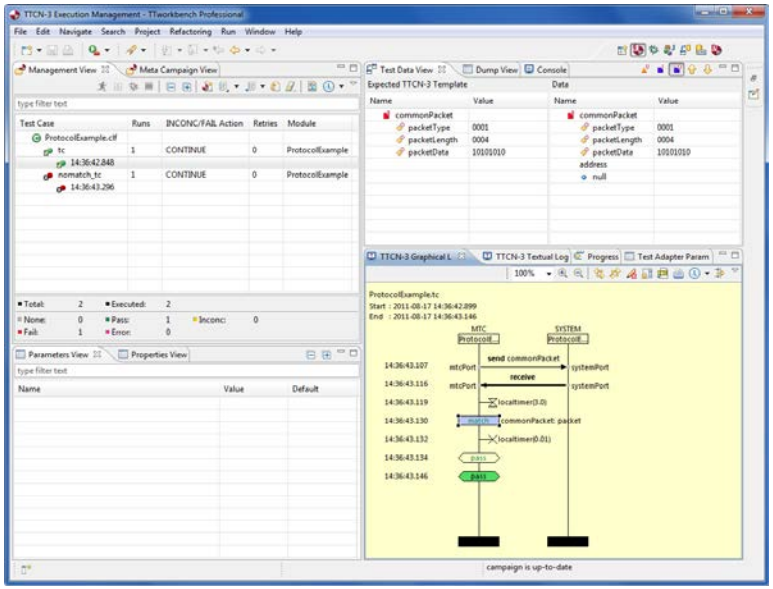
Initially concentrating on IEEE 802.11, IEEE 1609.3 and IEEE 1609.2

In the future extending towards IEEE 1609.4, SAE J2735 & SAE J2945/1

- Spirent TTWorkbench
- R&S ITS 100
- Others

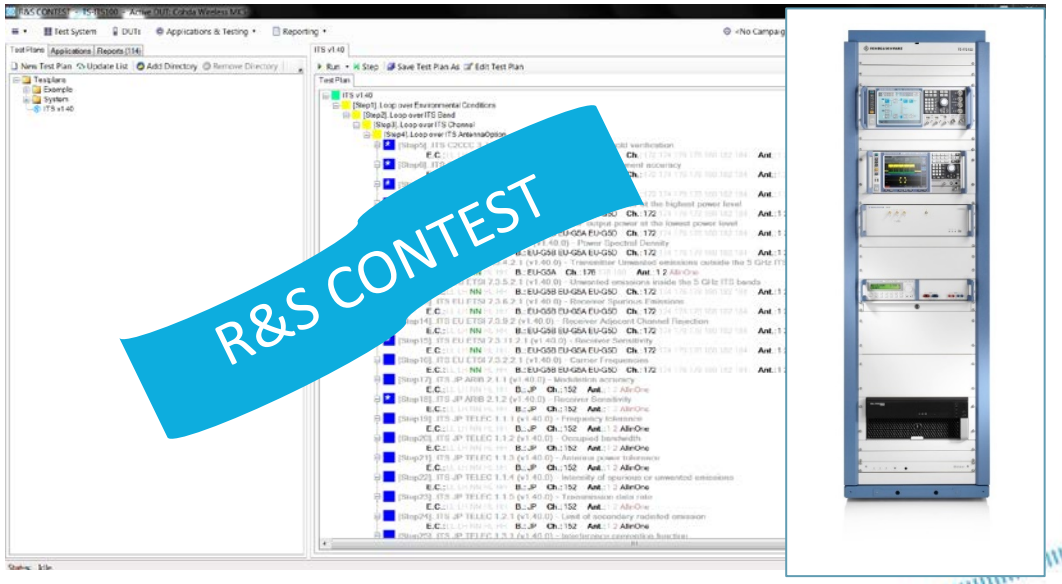
TEST SYSTEMS

Spirent TTworkbench



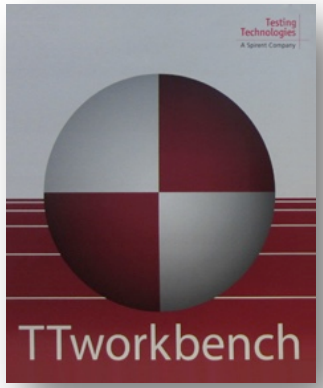
TS-ITS100

RF Conformance Test System for 802.11p

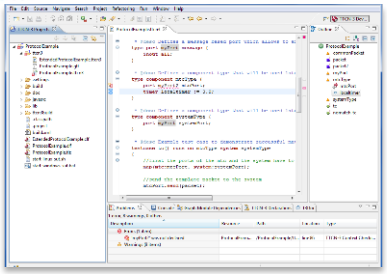


SPIRENT TTWORKBENCH SUMMARY

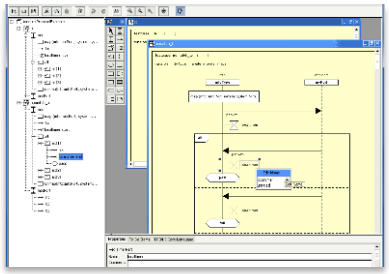
- Graphical test development and execution environment using TTCN-3
- Open extensible framework based on Eclipse, Java-based
- Full range of features needed for
  - Test specification, execution, analysis, reporting, debugging
  - Test suites are prepared for full test automation via direct connection to DUT
- Supports for COC test specifications
- Protocol conformance test suites for European V2X ITS-G5 according to the ETSI test specification



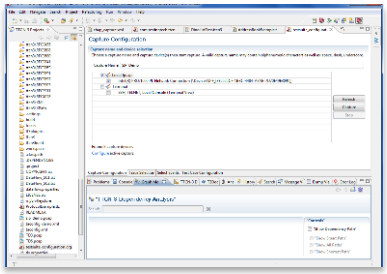
TEST DEVELOPMENT & EXECUTION



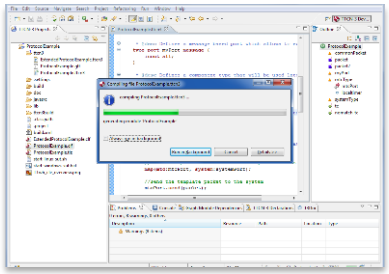
Test Scripting



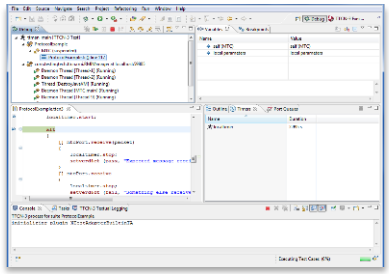
Graphical Test Specification



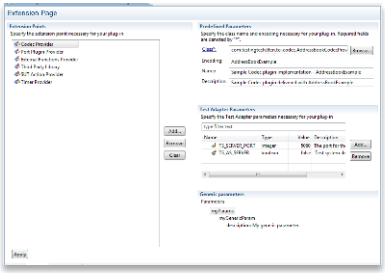
Test Capturing



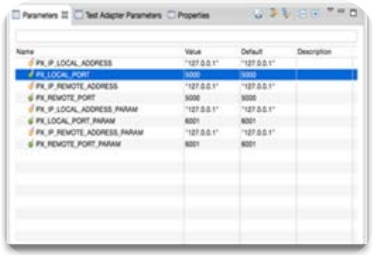
Test Compiling



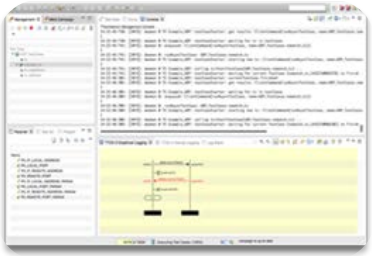
Test Debugging



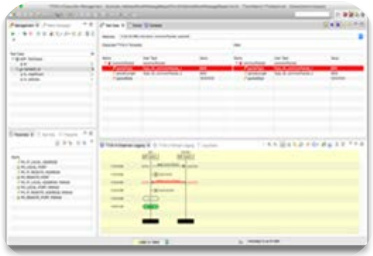
Test Adaptation Development



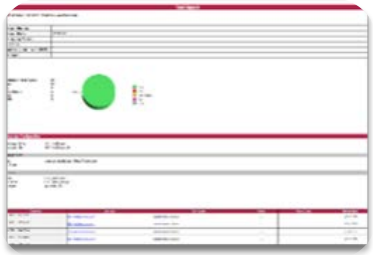
Test Configuration



Test Run



Results analysis



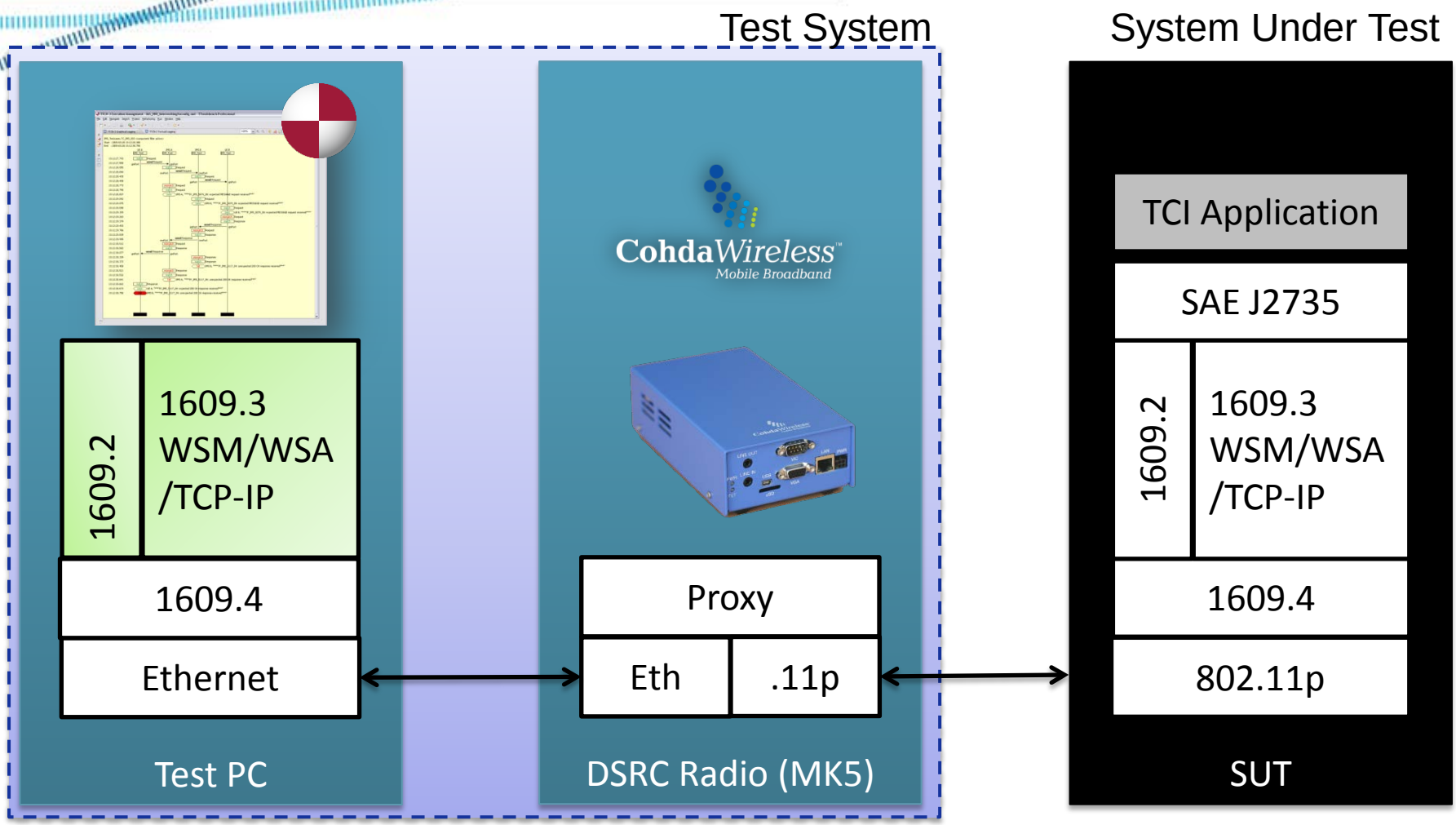
Test reporting

TESTING AND TEST CONTROL NOTATION VERSION 3

Community www.ttcn-3.org

- Standardized testing technology developed and maintained by ETSI
  - Specifically designed for testing and certification
- The TTCN-3 approach is extremely flexible and independent of
  - Technology
  - Operating system
  - Implementation domain
  - Scalable
  - Extensible
- Accepted by several standards organziations
  - Other testing standards use TTCN-3
    - Car2Car CC / ETSI / ITU-T / 3GPP / OMA / EUROCONTROL / MOST Cooperation / oneM2M

DSRC-WAVE TEST SYSTEM SETUP



TTworkbench Bridge setup

PC using Spirent TTworkbench

Cohda MK5 (Bridge)

SUT

TEST CASE EXECUTION & PARAMETER ADJUSTMENT

TTCN-3 Execution Management - TTworkbench Professional

File Edit Navigate Search Project Refactoring Run Window Help

Quick Access | TTCN-3 Development | TTCN-3 Execution Management | Plug-in Development

Management | Meta Campaign

type filter text

Test Case	Runs	INCONC/FAIL Acti...	Retr...	Module
ItsBtp_TestControl				
btpPacketGeneration				
btpBtpA				
TC_BTP_PGA_BV_01	1	CONTINUE	0	ItsBtp_TestC...
btpBtpB				
btpPacketProcessing				

1) Test case selection

Total: 5 Executed: 1

None: 0 Pass: 1 Inconc: 0 Fail: 0 Error: 0

Parameters | Test Adapter Parameters | Properties | Log Stack

2) Parameter setting

type filter text

Name	Value	Default	Description
otherSyncModuleDefinitions			
syncModuleparams			
PX_TSYNC_TIME_LIMIT	120.0	120.0	Default time limit for a sync client to reacl
PX_TSHUT_DOWN_TIME_LIMIT	120.0	120.0	Default time limit for a sync client to finisl
timeLibModuleParameters			
PX_TDONE	120.0	120.0	Time to control PTC.stop
PX_TAC	30.0	30.0	Time to control the reception of a messa
PX_TNOAC	10.0	10.0	Time to control that IUT sends nothing
PX_TWAIT	120.0	120.0	Time to control that IUT reacts prior to U
PX_LOOP	1.0	1.0	Time to control sending in loops
PX_IUT_STATION_ID	1	1	IUT Station Id Station Id used in CAM/D
PX_IUT_STATION_TYPE	5	5	IUT Station Type Station Type used in (
PX_TESTER_STATION_ID	111111	111111	Tester Station Id Station Id used in CAM

Test Data | Dump | Bridge 169.254.113.21 | IUT

SSH Connector: (user@169.254.113.25 - CONNECTED) - Encoding: (ISO-8859-1)

```
root@MK5:/mnt/ubi/c2x-app# ./ ets-btp.conf
-bash: ./: Is a directory
root@MK5:/mnt/ubi/c2x-app# ./c2x-app_mk5_release -c ets-btp.conf
main FNSTART: App Init...
App Init...
libPlat_Init FNSTART: ()
confF[0] = fopen(./ets.conf) = (nil)
Defaults file "./ets.conf" not available
confF[0] = fopen(ets-btp.conf) = 0x33bdb8
fclose(confF[0]): 0x33bdb8
Log directory is /mnt/ubi/log/2016.0311.2250_C04E548017119-0_2332
libPlat Init...
libITSNet Init...
libITSFL Init...
RUNNING...
```

3) Command log

TTCN-3 Graphical Logging | TTCN-3 Textual Logging | Internal Web Browser

4) Progress & verdict

	MTC LibItsBtp...		SYSTEM LibItsBtp...
14:50:38.672	tc ac(30.0)		
14:50:38.676	btpPort	receive BtpInd / mw btpInd	btpPort
14:50:38.692	tc ac(0.02)		
14:50:38.692	*** TC_BTP_PGA_BV_01: PASS: BTP-A packet correclty received ***		
14:50:38.696	pass		
14:50:38.696	**** f_selfSync: Successfully passed TEST BODY synchronization point. ****		
14:50:39.159	pass		

Campaign status

TEST REPORT

file:///C:/Users...TestControl.html

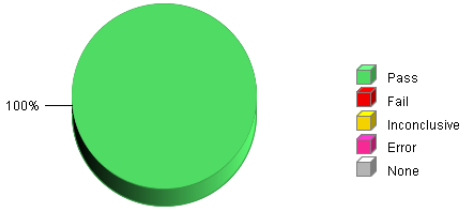
file:///C:/Users/operator/workspace/TTsuite-ITS_1.3.1/ItsBtp_TestControl.html

Test Report

provided by TTworkbench Professional 1.1.21.201511231329I

Report Number	
Report Date	2016-03-11
Company Name	
Test Lab	
System Under Test (SUT)	
Release	

Number of Test Cases	1
Pass	1
Fail	0
Inconclusive	0
Error	0
None	0



Campaign Configuration

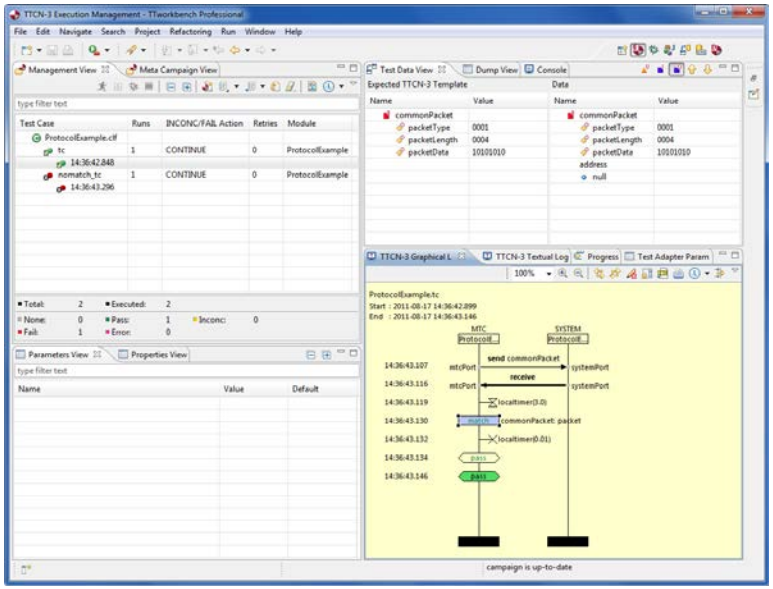
Campaign Name	ItsBtp_TestControl
Campaign File	ItsBtp_TestControl.clf

Test Adapter

Class	com.testingtech.ttcn.tri.PluginTestAdapter
File Name	

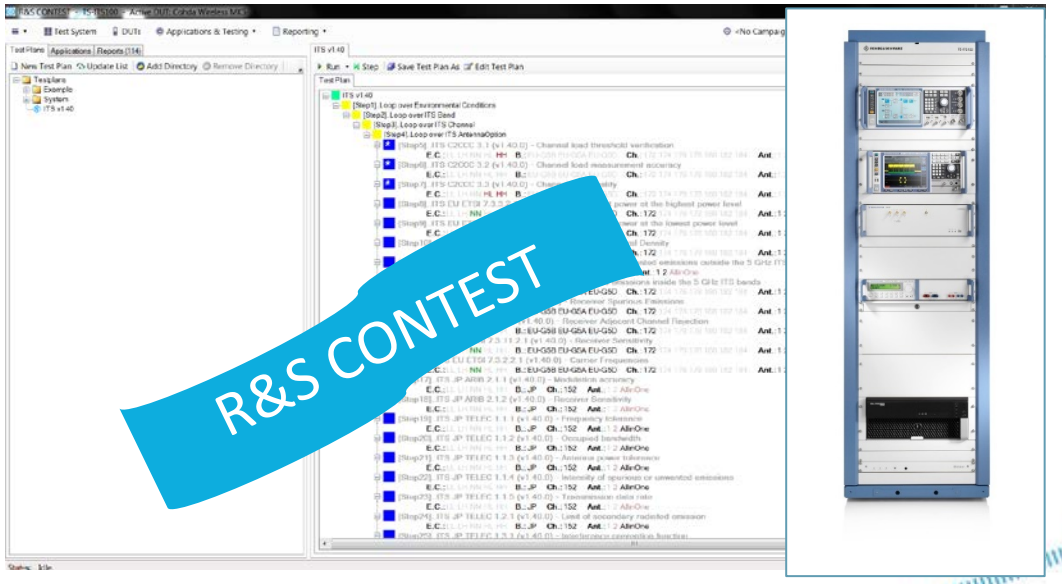
TEST SYSTEMS

Spirent TTworkbench



TS-ITS100

RF Conformance Test System for 802.11p



TS-ITS100

RF Conformance Test System for 802.11p

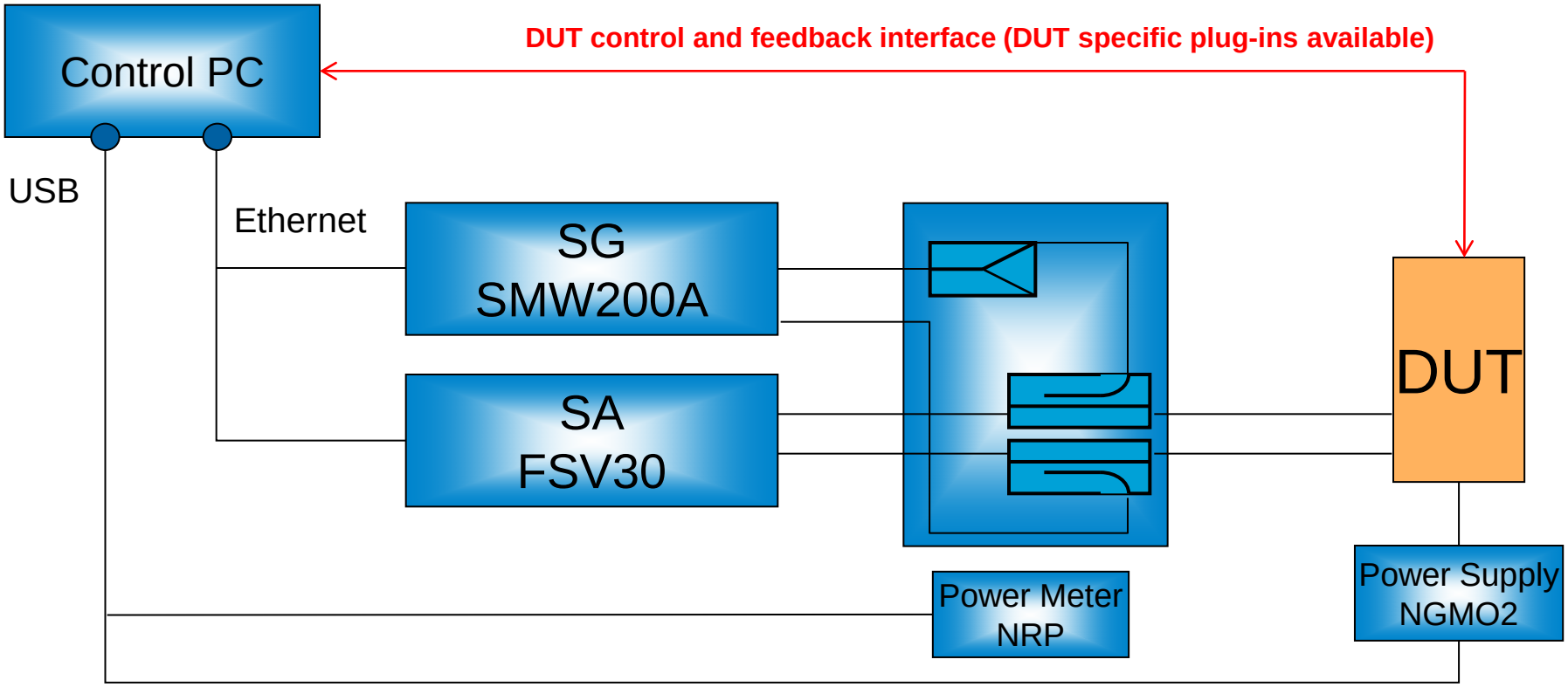
Basic setup

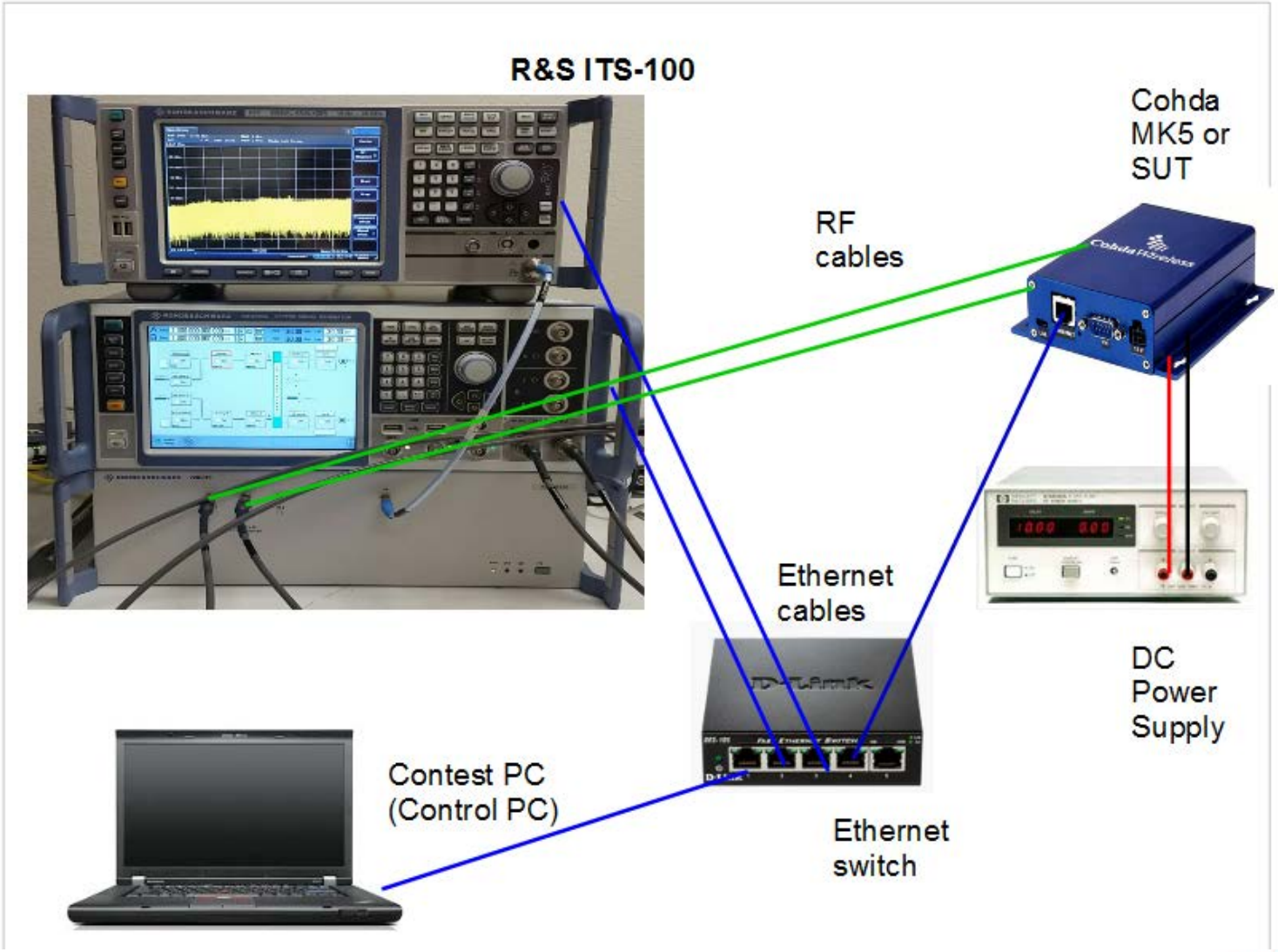
- R&S®**SMW200A** Vector Signal Generator
- R&S®**FSV30** Signal and Spectrum Analyzer (alternative FSW)
- R&S®**OSP-ITS** Antenna switch / combiner + Filter
- R&S®**NRP-Z81**, R&S®**NRP-Z31** Power Meter
- R&S®**NGMO**, Control PC, Cable set, rack

Optional extension

- R&S®**SMBV100A** Satellite simulator (for GNSS simulation)

TS-ITS100 - BLOCK DIAGRAM




R&S ITS-100
Cohda MK5 or SUT
RF cables
Ethernet cables
DC Power Supply
Contest PC (Control PC)
Ethernet switch

Supported COC 802.11 Test Cases based on IEEE 802.11

- COC TP-80211-TXT-PHY-BV-01 Spectrum mask
- COC TP-80211-TXT-PHY-BV-02 Center frequency tolerance
- COC TP-80211-TXT-PHY-BV-03 Symbol clock frequency tolerance
- COC TP-80211-TXT-PHY-BV-04 Constellation RMS error
- COC TP-80211-TXT-PHY-BV-05 Spectral flatness
- COC TP-80211-TXT-PHY-BV-06 Center frequency leakage
- COC TP-80211-TXT-PHY-BV-07 Transmit power function
- COC TP-80211-RXT-PHY-BV-01 Minimum input sensitivity
- COC TP-80211-RXT-PHY-BV-02 Adjacent channel rejection
- COC TP-80211-RXT-PHY-BV-03 Nonadjacent channel rejection
- COC TP-80211-RXT-PHY-BV-04 Maximum input level
- COC TP-80211-RXT-PHY-BV-05 Received channel power indicator measurement
- IEEE 18.3.9.4 Transmission spurious

TS-ITS100 – ADDITIONAL TESTS

Available on TS-ITS100

Additionally supported other regional tests:

- **RF Regulatory tests according to R&TTE ETSI EN 302 571**
- **RF Performance tests according to C2C-CC / ETSI**

- **RF Regulatory tests according to ARIB STD-T109**
- **RF Regulatory tests according to TELEC T257**

DUT PLUGINS

Vendor	DUT	Plugin	Product
Autotalks	Pangaea 3	AutotalksPangaea	ITS-KT120
	Pangaea 4		
Cohda Wireless	MK 2	CohdaMK2	ITS-KT110
	MK 3	CohdaMK3	ITS-KT111
	MK 4	CohdaMK4	ITS-KT112
	MK 5	CohdaMK5	ITS-KT113
Commsignia	ITS-OB2-M	Commsignia ITS-OB2-M	ITS-KT150
Qualcomm	Only available to QC registered customers	Qualcomm1	ITS-KT140
Renesas	C2X Rev. 2	RenesasC2XRev2	ITS-KT130
	C2X Tortuga		

TS-ITS100 SUMMARY

- **Testing benefits:**
  - ✓ Fully automated RF test solution
  - ✓ Support for the COC 802.11, EU and JP specifications
  - ✓ Reproducible Test Results
  - ✓ RF filter for Out-of-band test cases included in OSP-ITS
  - ✓ Manufacturer-specific plug-ins for user equipment

- **R&D benefits:**
  - ✓ Test Case parameters can be changed
  - ✓ Easy to use Contest GUI
  - ✓ Extensive test, report and analysis functionalities

DUT REQUIREMENTS

- DUT requirements to use Spirent TTWorkbench
  - Support for 2016 versions of IEEE 1609.3 and IEEE 1609.2
  - Support for TCI interface to the test system

- DUT requirements to use R&S ITS-100
  - Support 802.11- 2012 version
  - Use of one the supported radios (Plug-ins)

WHERE TO GET MORE INFORMATION

The Certification Operating Council: certificationoperatingcouncil@**gmail.com**

Certification Test specifications:
https://github.com/certificationoperatingcouncil/COC_TestSpecs

Test Control Interface Specification:
https://github.com/certificationoperatingcouncil/TCI_ASN1

Test Control Interface Tools:
https://github.com/certificationoperatingcouncil/TCI_Tools

Spirent Test System (TTsuite – WAVE – DSRC)
https://www.spirent.com/Products/TTworkbench/TTsuites/WAVE-DSRC
(or contact Matt Griswold **Matthew.Griswold@spirent.com**)

R&S®TS-ITS100 RF Conformance Test System
http://www.rohde-schwarz.com/en/product/ts-its100-productstartpage_63493-62017 (or contact Mike Miller **Mike.Miller@rsa.rohde-schwarz.com**)

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