Protocol Tester R&S PTW60 for Bluetooth™ Solutions

Bluetooth test solutions all in one – from development to conformance testing

R&S PTW60 applications

◆ Integral component in the development of protocol layers, profiles and applications

◆ Transparent integration of *Bluetooth* components

◆ Approved reference for protocol and profile conformance tests

Main functions

◆ Reference implementation of baseband, LM, L2CAP in master and slave mode

◆ Simulation of a *Bluetooth* pico-network

◆ Automatic generation of executable test cases from official test vectors issued in TTCN by *Bluetooth* Special Interest Group (SIG)

◆ Support of official conformance tests for baseband, LM, L2CAP, GAP, SDP and SPP

◆ Powerful test script package for easy analysis of implementation under test (IUT)

◆ Comprehensive choice of problem-oriented analysis tools (PCOs, MSCs, TTCN traces)

◆ Flexible internal and external programming interfaces for adaptation to special measurement tasks

ROHDE & SCHWARZ

Rohde & Schwarz has played an active part in the development of *Bluetooth* wireless technology since 1999. The Protocol Tester R&S PTW 60 (validated by the *Bluetooth* SIG in April 2002) reflects the company's long-standing experience and problem-solving capacity.

The Rohde & Schwarz *Bluetooth* expert team helps customers with any questions relating to the R&S PTW 60 and *Bluetooth* protocol analysis. Regular software updates ensure that the R&S PTW 60 is always up to date. The company's active participation in the various *Bluetooth* bodies ensures prompt implementation of the latest trends.

The commitment of Rohde & Schwarz with respect to official test cases in particular makes for reliability of results and safeguards the customers investments.

The Rohde & Schwarz *Bluetooth* Protocol Tester R&S PTW 60 offers professional and comprehensive protocol test and analysis functions. It is ideal for use in the development and qualification testing of *Bluetooth* products. Equipped with programming interfaces, the R&S PTW 60 is even suitable for developing new protocols. Rohde & Schwarz, unlike most of its com-
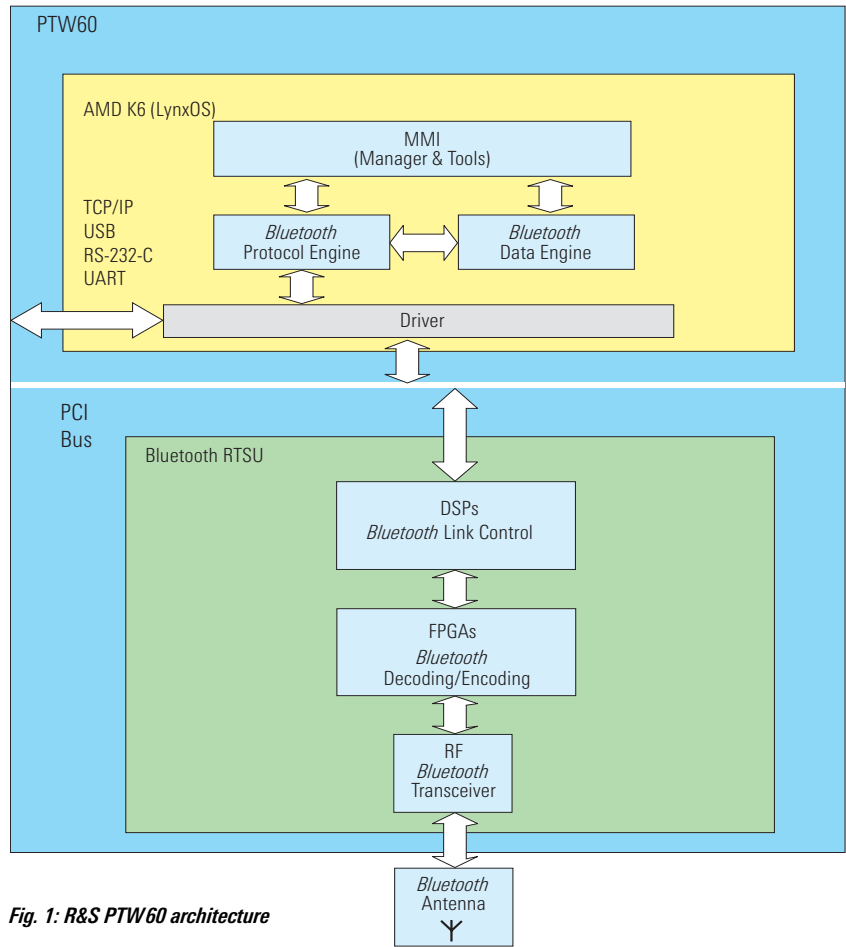

Fig. 1: R&S PTW 60 architecture

petitors, has adopted the strategy of developing protocol layers and the technology-dependent hardware completely on its own.

This allows the simulation of protocol errors at all layers, which enables an IUT's error tolerance and robustness to be determined for example.

Hardware

Hardware components:

◆ Industrial computer with *Bluetooth* RTSU (realtime signalling unit)
◆ External interfaces for networking (Ethernet) of R&S PTW 60 and connection of *Bluetooth* TCI (test controller interface) via UART, RS-232-C and USB
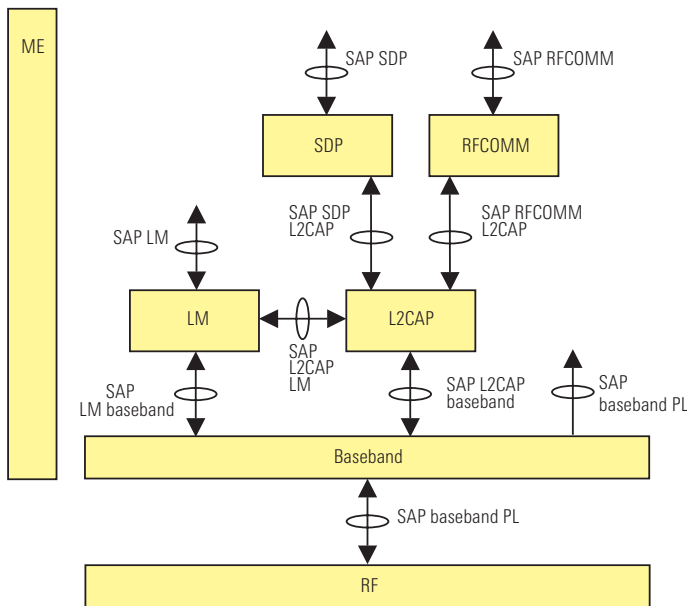

Fig. 2: R&S PTW 60 protocol data flow and Service Access Points

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Software

R&S PTW 60 *Bluetooth* protocol stack
Fig. 2 illustrates the *Bluetooth* layer structure and the logic data flow. The baseband, LM (link manager) and L2CAP (logical link control and adaptation protocol) layers can be separately configured, started and stopped.

The realtime LynxOS operating system (realtime UNIX derivative) allows online protocol analysis. The IUT can be evaluated from the data output at the service access points (SAPs).

The analysis and graphic display tools of the R&S PTW 60 can be tailored to user requirements – from detail analysis to overview displays.

Stimulus tools

Platform concept with open programming interface
The protocol testers from Rohde & Schwarz are of modular design, i.e. the protocol layers are interlinked via defined interfaces. The use of a uniform function and command format allows access to the individual protocol layers using the C and C++ programming languages.
This offers the following advantages:
◆ The protocol tester is a safe investment as it can be extended and adapted to customer requirements.
◆ A comprehensive script package supplied with the tester facilitates analysis of the protocol layers and evaluation of the standard procedures in the IUT.
◆ The customer can easily generate test scripts of his own tailored to his specific applications.
◆ The protocol tester can be integrated into customer-specific test environments and remotely controlled via a TCP/IP socket interface (Ethernet).
◆ Automatic regression tests are possible by networking test scripts and manipulating the protocol layers.

Test script manager and executor
Test scripts can be selected and started by means of the test script manager, which also facilitates archiving, finding, editing and compiling existing test scripts.

Existing test scripts can be modified quickly and easily by means of the test script editor, allowing scripts to be adapted to new applications in only a short time. The test run is controlled via the test script executor. Manual or automatic execution of the test steps can be selected.

The current test steps and commands are displayed so that the user is always informed of the test sequence status.

Protocol tests without air interface
All protocol layers can be connected to the IUT via a commercial Ethernet link. This functionality is useful for testing individual protocol layers without air interface. The following protocol SAPs can be directly connected to the IUT protocol layers:
◆ X-L2CAP (for layers above L2CAP)
◆ SDP - L2CAP
◆ RFCOMM - L2CAP
◆ L2CAP-LM
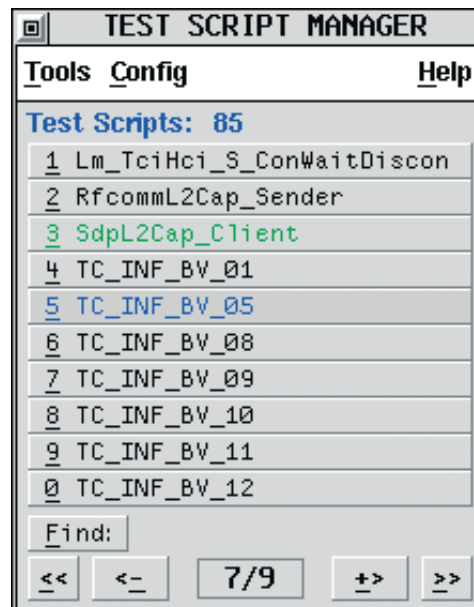◆ L2CAP-SAR
◆ L2CAP-LC
◆ LM
◆ LM-LC

Fig. 3: Test script manager and executor

TTCN toolbox and *Bluetooth* simulation libraries

Compiler process

The Protocol Tester R&S PTW60 for *Bluetooth* Solutions automatically converts the TTCN (tree and tabular combined notation) test cases developed by the *Bluetooth* SIG to executable code. Fig. 4 illustrates this procedure. The *Bluetooth* SIG test vectors are copied to the R&S PTW60 in TTCN.mp format and initially translated by the TTCN compiler into ANSI-C code. An automatic syntax check is performed on the TTCN code. In addition to the .c and .h files, all make files needed for the compiling operation are generated automatically. After the C compiler has processed the code, the linker generates executable test programs from the resulting object files and the simulator and protocol library of the specific *Bluetooth* SIG test vector.

Bluetooth simulation libraries

For the R&S PTW60, Rohde&Schwarz offers the following simulation libraries for the automatic generation of *Bluetooth* SIG test vectors:

◆ Baseband (BB)
◆ Link manager (LM)
◆ Logical link control and adaptation protocol (L2CAP)
◆ Generic access profile (GAP)
◆ Service discovery protocol (SDP)
◆ Serial port profile (SPP)

Test suite parameter editor

Before running the test cases of a *Bluetooth* SIG test vector, the properties and parameters for the implementation under test must be entered in the form of PICS/PIXIT information (protocol implementation conformance statements/protocol implementation extra information for testing). Based on this information, test cases are selected, alternatives activated and deactivated in the individual test cases and implementation-specific parameters are set. This information can easily
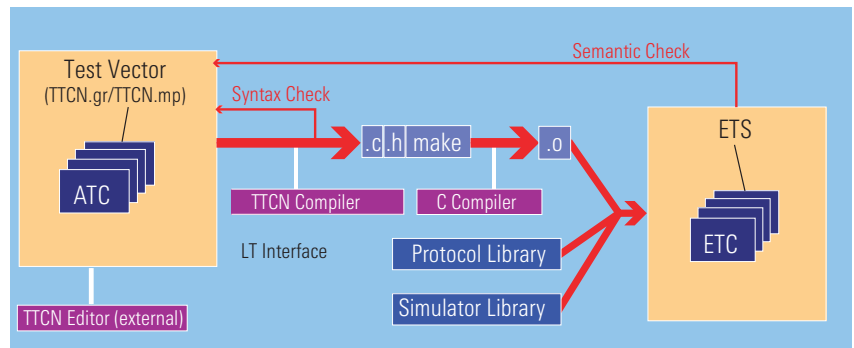

Fig. 4: Conversion of abstract test suites (test vectors given in TTCN-format) into executable test suite

be adapted by means of the R&S PTW60's test suite parameter editor, a tool that enables the user to manage any number of PICS/PIXIT files for different IUTs and eliminates the need to re-enter the very complex *Bluetooth* settings every time the IUT is changed. For the bit strings frequently used in test vectors, which may be several hundred bits in length, the test suite parameter editor of the R&S PTW60 enables hexadecimal or octal entry with automatic conversion to the PICS/PIXIT format required for the specific test vector.

Test case manager

The executable test cases are available in the test case manager (Fig. 5) of the R&S PTW60, a tool for setting up and performing any sequence and repetition of test cases.

All outputs from the running test cases are processed by the test case manager in realtime and made available to the user.

The run logs generated by the test case are strictly oriented to the executed lines of the TTCN test case; this allows simple correlation with the easily readable, tabular TTCN code (TTCN.gr).
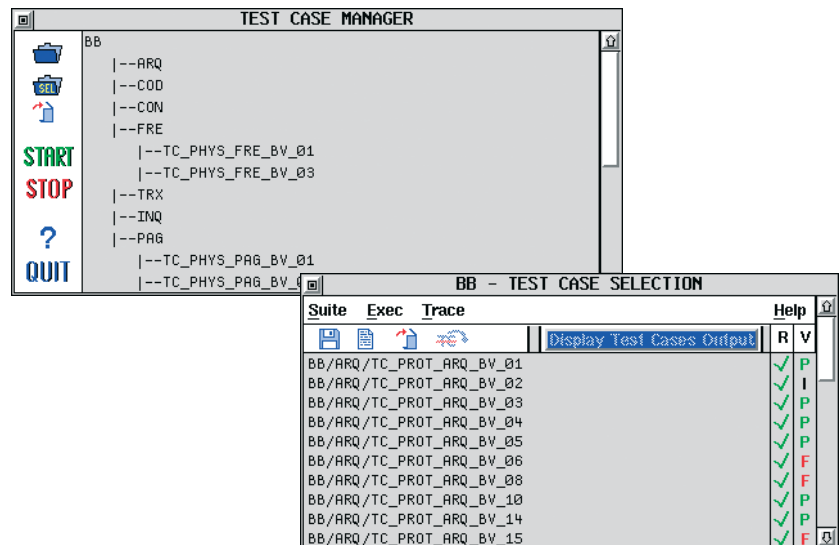

Fig. 5: Test case manager and test case selection

The test case selection expression provides the user with an easy means of selecting the test cases of a *Bluetooth* SIG test vector that are appropriate for a particular IUT (implementation under test).

The test case selection box (Fig. 5) displays the result for each test case in a simple and straightforward manner. Possible results are PASS (P), INCONCLUSIVE (I), and FAIL (F).

External TTCN editor

Leonardo Synergy Solution™
by Da Vinci Communications Ltd
This R&S PTW 60 plug-in provides a practice-oriented, integrated solution for developing, editing and debugging *Bluetooth* SIG test vectors on the Protocol Tester R&S PTW 60.
Key features:
◆ Remote control of TTCN compiler on R&S PTW 60
◆ Return of error messages for debugging
◆ Remote management of build directory structure
◆ Management of different users and test vector versions
◆ Online help for plug-in

Analysis tools

The R&S PTW 60 offers a wide range of analysis tools, including PCOs (points of control and observation), MSCs (message sequence charts) and TTCN traces.

TTCN traces
Detailed TTCN trace files (Fig. 7) provide information on the IUT's response when subjected to the *Bluetooth* SIG test cases.
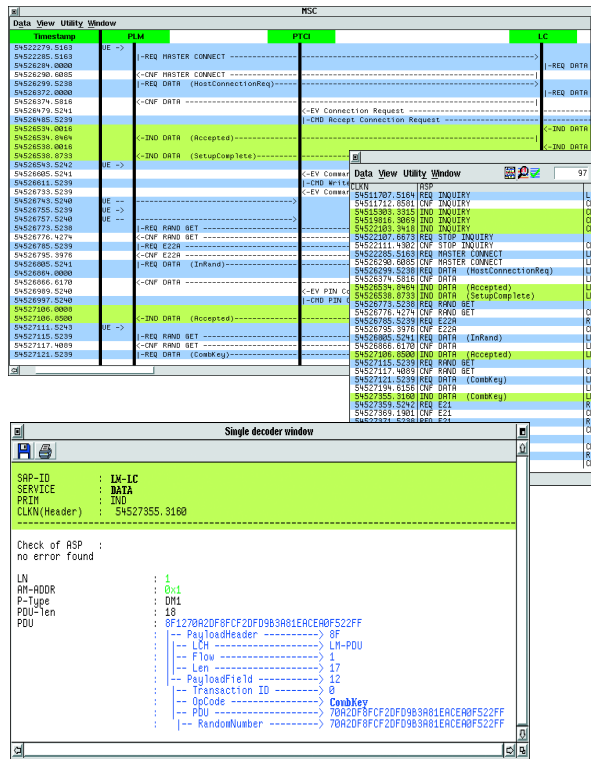

Fig. 6 MSC, PCO and single message decoder

Message sequence chart (MSC) and point of control and observation (PCO)
PCOs and MSCs can display and interpret both received and transmitted data (Fig 6).

A PCO represents data referred to a single service access point (SAP), whereas a MSC displays protocol data units (PDUs) across all protocol layers in a chronological order.
All available PCOs base on the SAPs according to the test specification defined by Rohde & Schwarz.

The analysis tools also provide the following functions:
◆ Filters for primitives, data packets, ID packets and PDUs
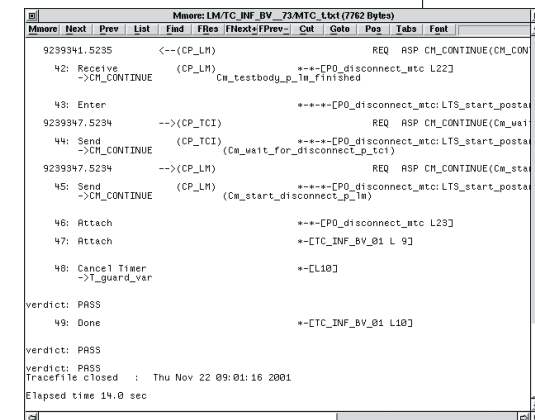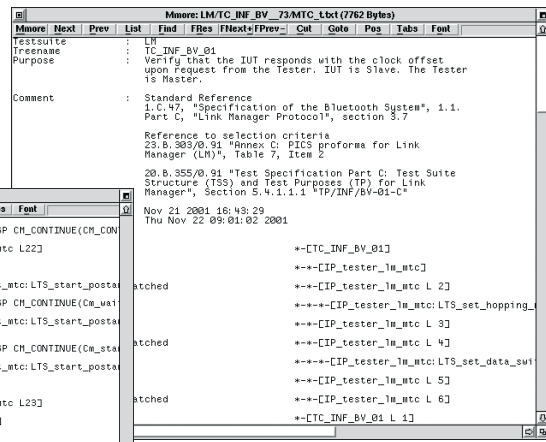◆ PDU decoders and ASP (abstract service primitive) checkers
◆ Single message decoders

Fig. 7 TTCN trace

Specifications

RF data

TX frequency range	2.402 GHz to 2.480 GHz
TX power range	−45 dBm to +13 dBm ±3 dB
RX frequency range	2.402 GHz to 2.480 GHz
RX input power range	−70 dBm to −20 dBm
TX and RX impedance	50 Ω
Modulation	GFSK with BxT = 0.5
Carrier spacing	1 MHz
Bit rate	1 Mbps

RF interfaces

Split RF connectors for RX and TX paths with N connectors on front panel
External reference inputs/outputs with BNC connectors on rear panel

Processor architecture	AMD-K6 processor with 233 MHz, 13 GB IDE hard disk, 128 MB RAM, 8.4" TFT colour LC display (640 x 480 pixels), 3.5" floppy disk drive, 3 PCI slots, 3 ISA slots
Digital interfaces	printer port, COM 1 with RS-232-C level, COM 2 with RS-232-C or TLL (5 V) level, microswitch-selectable, dual-port USB connector, VGA connector for external monitor

General data

Environmental requirements

Rated temperature range	+15 °C to +35 °C
Operating temperature range	+5 °C to +40 °C, meets DIN EN 60068-2-2
Storage temperature range	−25 °C to +60 °C
Relative humidity	95% at +40 °C without condensation, meets DIN EN 60068-2-3(0)

Mechanical resistance

Vibration, sinusoidal	5 Hz to 150 Hz, meets DIN EN 60068-2-6
Vibration, random	5 Hz to 300 Hz, meets DIN EN 60068-2-64
Shock	40 g shock spectrum meets DIN EN 60068-2-27
Power supply	100 V to 240 V AC, 1.3 A to 3.1 A, 50 Hz to 400 Hz

Regulatory requirements

Electromagnetic compatibility meets EMC directive of EU

EMC standards met	EN 61326:1997 + A1:1998 +A2:2001 noise suppression class A, immunity to noise for use in industrial areas
Safety standards met	EN 61010-1: 1994-03, EN 61010-1:1993 EN 61010-1/A2:1995-05, EN 61010-1/A2:1995, IEC 1010-1:1990-09, IEC 1010-1/A1:1992-09, IEC 1010-1/A2:1995-06

Software

Operating system LynxOS 3.0.1 or higher, graphical user interface MGR 2.20b or higher

Mechanical data

Dimensions (W x H x D)	412 mm x 197 mm x 417 mm
Weight	10 kg

Ordering information

R&S PTW60 Basic System	R&S PTW60	1133.3006.02
Library for Compilation and Execution of Test Case Package; Baseband	R&S PTW60BB	1133.3741.02
Library for Compilation and Execution of Test Case Package; Generic Access Profile	R&S PTW60GA	1133.4148.02
Library for Compilation and Execution of Test Case Package; Link Manager	R&S PTW60LM	1133.3841.02
Library for Compilation and Execution of Test Case Package; Logical Link Control and Adaptation Protocol	R&S PTW60L2	1133.3793.02
Library for Compilation and Execution of Test Case Package; Service Discovery Application Profile	R&S PTW60SD	1133.4048.02
Library for Compilation and Execution of Test Case Package; Serial Port Profile	R&S PTW60SP	1133.4090.02
R&S PTW60 Package 1: Basic System and Libraries for Compilation and Execution of Test Case Package (BB, LM, L2CAP)	R&S PTW60P1	1133.3893.02
R&S PTW60 Package 2: Basic System and Libraries for Compilation and Execution of Test Case Package (GAP, SPP, SDAP)	R&S PTW60P2	1133.3941.02
R&S PTW60 Package 3: Basic System and Libraries for Compilation and Execution of Test Case Package (BB, LM, L2CAP, GAP, SPP, SDAP)	R&S PTW60P3	1133.3993.02
Encryption Key, length 128 bit (export licence required!)	R&S PTW60EK	1133.4190.02

Software service contracts

Software Service for Basic Unit, one year	R&S PTW-SSB-1	1155.9507.11
Software Service for simulation libraries BB, LM, L2CAP, GAP, SPP or SDP	R&S PTW-SSxx	R1155.9507.xx

R&S PTW60 Training

Operator's Training	0844.2987.xx
Programmer's Training	0844.2987.xx

For more detailed information please contact your local representative.

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