

## GPRS Function Test using TTCN

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The introduction of General Packet Radio Services brought with it a challenge to carry out functional and conformance tests. Never before have a large number of telecom and datacom protocols been combined in a single network element. Demands to the test system were high, as the system should be able to grow with the implementation, support a large variety of protocols in different national variants and be utilized in simulated and target environment.

General Packet Radio Services (GPRS) is a standardized extension to existing GSM networks that offers packet switched data services. Two new network elements will be added to the GSM network architecture: the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN). These nodes are interconnected by means of an IP based core network and have signaling connections to existing GSM network elements such as Home Location Registers (HLR), Mobile Services Switching Center/Visitor Location Registers (MSC/VLR), Base Station Controllers (BSC) or Short Message Service Gateway MSCs and Interworking MSCs (SMS-GMSC, SMS-IW MSC). The SGSN serves packet data users in a defined geographical area while the GGSN connects to external packet data networks. From an end user's perspective GPRS offers permanent connectivity to IP networks, volume based charging and a higher bandwidth compared to existing GSM data services up to 115 Kbps. Circuit switched GSM services and packet switched GPRS services can coexist without disturbances, only one HLR based subscription is needed. Radio resources can be shared efficiently among several users. Horizontal applications (e.g. e-mail, FTP, HTTP) and vertical applications (such as telemetry, diagnostics, vending machines) can be offered. In addition SMS will be supported over GPRS.

TTCN (Tree and Tabular Combined Notation) is an internationally standardized test notation designed for testing of protocol implementations based on the OSI Reference Model. It can be used for specifying different types of tests used during different project phases and supports good logical structuring of test objects and good support for complex data structures including usage of ASN.1 (Abstract Syntax Notation One).

There are many protocols and interfaces in the GPRS network. Different protocols are used on different interfaces and all nodes interfacing the SGSN/GGSN have to be simulated, therefore testing a GPRS support node requires a complex test configuration simulating the other nodes adjacent to this entity. These expectations can be met by using *concurrent TTCN*. Not all the interfaces are available from the first design increment on: The test system is becoming more and more sophisticated as the design grows and even the protocols may change during the design due to standardization changes. *Modular TTCN* provides the possibility to upgrade the test suites easily, handles large sized test suite production and facilitates parallel work. The same test cases shall be executable in simulated and target environment as well as for different design increments that need to be maintained. This emphasizes the need to enable or disable different functionality. Testers can write easily adaptable test cases for different use cases by parameterized *TTCN test suites*.

TTCN test suites are independent of test methods, layers, protocols or test tools, so TTCN is applicable under many conditions. It enables the handling of different protocols and multiple interfaces in one test suite and supports testing of complicated systems like the GPRS support nodes combining telecom and datacom protocols. TTCN provides powerful means of modularization and parameterization of test suites.

A total of approximately 2500 test cases distributed over ca. 50 test objects has been produced and executed during the GSN verification project using TTCN. A large subset of these test cases has been repeated in all design increments (regression test) and helped to secure the product quality with a minimum of test case redesign.