

Summary

Monitoring, performance testing, simulation, and emulation are crucial steps in the process of verifying the functionality and efficiency of individual network elements or the operator's entire network. With the K1297, Tektronix offers a protocol tester and software to support these tasks.

During the installation process, the user of the Tektronix K1297 can set up the tester's operating mode. When setting up the K1297, the user determines [1] whether to test the SS7 signaling plane (starting with the MTP protocol) or the GPRS interfaces (beginning with Frame Relay).

With the decision for SS7, both the Gr "MAP" interfaces and the Gs (BSSAP+) interface can be tested.

When GPRS interfaces are tested, the DLCI value of the Frame Relay header indicates whether complete Frame Relay data is present [see 2, DLCI=0], or if the information is a full GPRS stack (Gb interface). If RFC1490 PDUs are found, the corresponding user part is selected (Gi and Gn interfaces).

In case of the Gb interface, for the emulation of the LLC and higher layers, the LLC SAPI (Service Access Point Identifier) [see 3] determines whether user data or short messages should be transmitted (SNDSCP, SMS) or Mobility Management (GMM/SM) will be handled.

On the Ethernet interface, the lower layers are replaced by Ethernet and MAC (Media Access Control). Above the MAC layer, a complete IP stack is found.

With these options, the Tektronix K1297 covers the full range of GPRS interface testing.

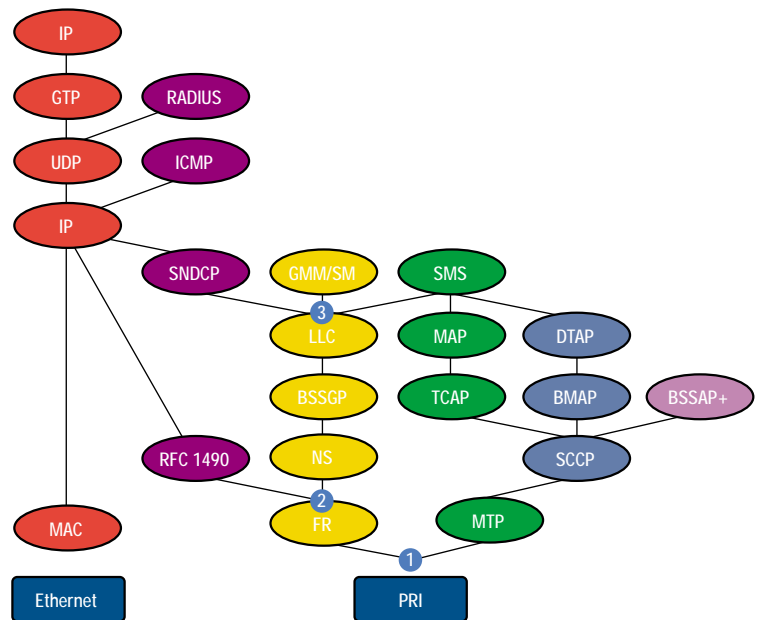
Conformance Testing [ETSI ETR O21]

The principal idea of standards is to allow the development of systems by different manufactures which can interoperate with each other. **Conformance testing** is the verification process in which an independent body determines if a system, piece of equipment or implementation satisfies the criteria of a particular standard. "During the test phase, the implementation is referred to as the **Implementation Under Test (IUT)**."⁹

The **conformance assessment process** specifies test methods to ensure the comparability of test results generated by different test laboratories. This process can be divided into three steps:

1. Test Preparation: the client (manufacturer) and the test laboratory agree on the test and the how to conduct it (including testing method and tested protocols). Here there are two important documents:

- Protocol Information Conformance Statement (PICS): describes the capabilities and the used options of the client's IUT. It also states which



features have been omitted.

- Protocol Implementation eXtra Information for Testing (PIXIT): holds additional information about the IUT important for the test laboratory, such as addressing information, complements for the range of values stated in the PICS.

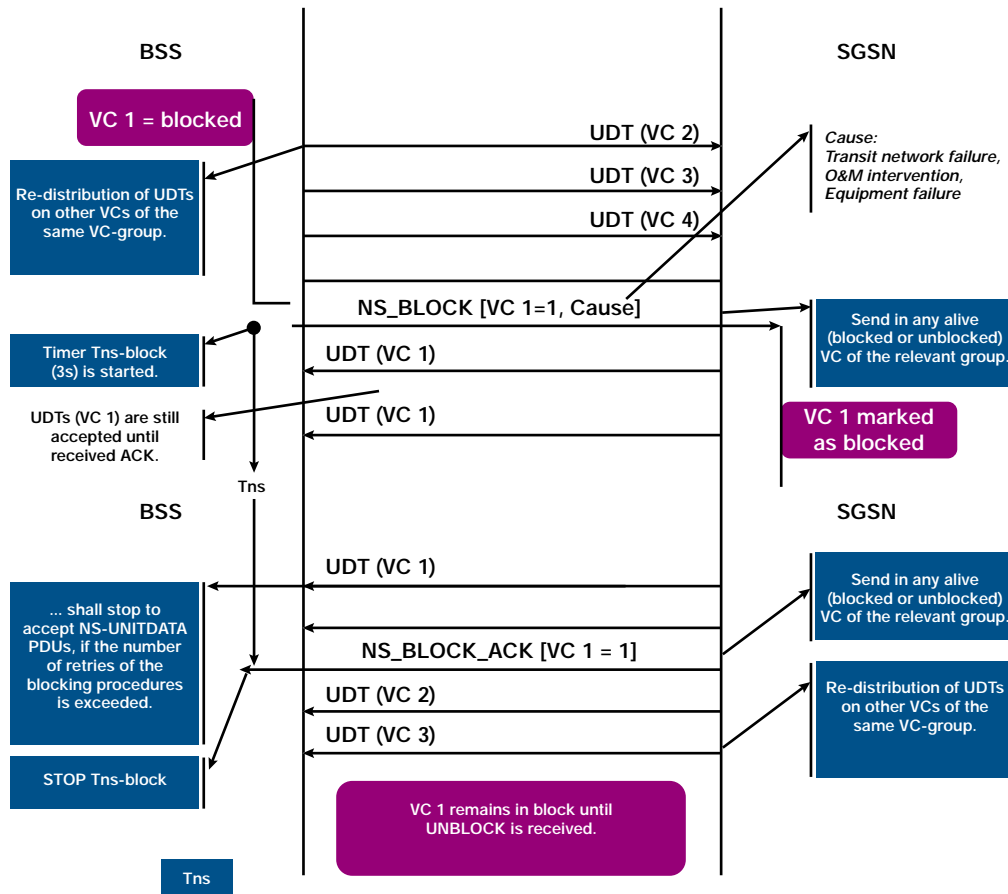
2. Test Operation: During this step, the tests are carried out. Normally a collection of executable tests are available, called Executable Test Suites (ETS). These are based on an abstract description of the tests, the so-called (standard) Abstract Test Suite (ATS).

3. Conformance Test Reports: Finally, the conformance test results must be made available. The Protocol Conformance Test Report (PCTR) holds the conformance test results for a single protocol layer including all necessary information (PICS, PIXIT, IUT). The System Conformance Test Report (SCTR) summarizes the conformance test results, identifying the participants (such as test laboratory, client, SUT) and a system report summary with a reference to the different standard components (such as protocols, PICS).

Simulation and Conformance Testing Example: Block Procedure NS

There are two new layers which enable peer-to-peer communication between the SGSN and the GPRS mobile station, the Subnetwork Dependent

⁹ ETSI ETR 021: September 1991, p. 8



► Figure 11: Block Procedure NS

Convergence Protocol (SNDSCP) layer and the Logical Link Control (LLC) layer. The Base Station System GPRS Protocol (BSSGP) and the Network Service (NS) are used between the BSS and SGSN.

Figure 11 shows a conformance test scenario for the NS layer. The “Remote Single Layer” testing method is applied (only functions and tasks are tested here, independent of lower and higher layers). For conformance testing, a set of Abstract Test Suites (ATS) is defined. Several refer to a specific event of the Network Service Virtual Connection (NS-VC) management: a blocking procedure is used by the NS entity to inform its NS peer entity when an NS-VC becomes unavailable for the NS user traffic (see Figure 11). The NS-VC management is part of the Network Service Control entity, which is also responsible for NS SDU transmission and load sharing.

User data traffic is transmitted on several virtual connections of one NS-VC group between the BSS and the SGSN. NS-VCs between the same peer entities are arranged in one NS-VC group. NS-VC grouping therefore has only local

significance between the BSS and SGSN.

- In Figure 11, the user data is transmitted on virtual connections 1 through 4.
- The BSS side then blocks the virtual connection VC1. The NS block packet contains the Virtual Connection Identifier (VCI, here 1) and a cause element, which indicates the reason for blocking the virtual connection. The most common reasons for blocking a virtual connection are transit network failure, O&M intervention, and equipment failure. The VC block packet may be sent on any alive (= blocked or unblocked) NS-VC that belongs to the same NS-VC group.¹⁰ When blocking the VC 1, the BSS must be capable of redistributing the user data traffic (NS-UNITDATA PDUs¹¹) on other virtual connections of the same NS-VC group.
- When blocking the VC 1, there can still be unitdata PDUs on the VC 1 from the SGSN to the BSS. Therefore, the BSS must still accept incoming user data traffic on VC 1. This happens either until the BSS side gets an

¹⁰ Some cases may require different handling.

¹¹ By the means of the NS-UNITDATA PDU, NS SDUs are transmitted in an unacknowledged mode via the G_b interface.

NS block acknowledge packet, or until the number of retries specified for the blocking procedure is exceeded. Then the TNS block timer stops.

- After sending the NS block acknowledge packet, the SGSN must distribute the user data traffic on the unblocked virtual connections.

Two possible conformance tests will be shortly portrayed. The conformance test of one entity can be realized via simulation: the BSS side or the SGSN can be simulated by a system simulator. If the SGSN is simulated, there are two possible test configurations shown in Figure 12: Test Configurations I & II:

- A test configuration for testing the Network Service Protocol and the BSSGP part where no GPRS mobile station is needed. The IUT is the BSS.
- A configuration for testing the BSSGP where the GPRS mobile station is needed. If the full implementation of the Gb interface has to be tested, then the LLC and SMDCP can also be examined. (The LLC and SMDCP can be partially tested by directly attaching the MS higher layers to a system simulator.)

So a system/network element simulator can be used for conformance test of one interface's entity.

Given the NS blocking procedure, the following two confirmation tests can be performed:

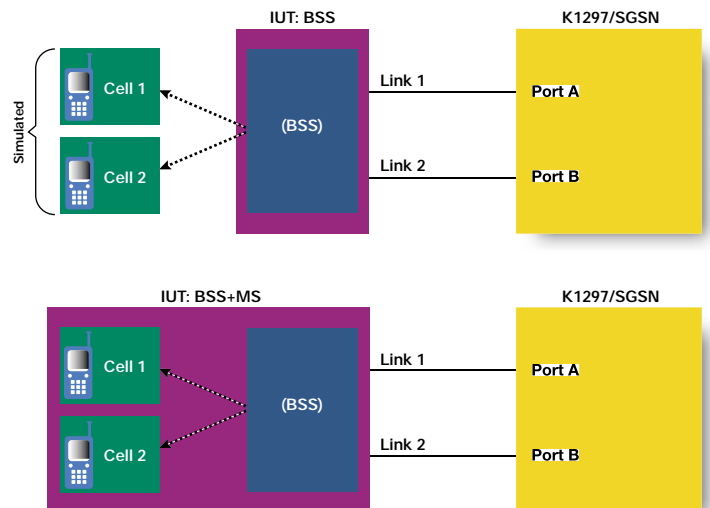
- Normal sequence of events when IUT receives an NS block acknowledge packet¹²:

When the IUT (BSS) receives an NS block acknowledge packet as a response to the O&M initiated NS block in the "NS-VC unblocked" state (the NS block acknowledge is received on another NS-VC belonging to the same group), the IUT should stop the blocking procedure and remain in the "NS-VC blocked & alive" state.

- Abnormal sequence of events when IUT receives an NS block acknowledge packet¹³:

When the IUT receives an unexpected NS block acknowledge packet for an NS-VC which is locally blocked (in the "NS-VC blocked & alive" state), the IUT should discard it and remain in "NS-VC blocked & alive" state.

The test case only passes if the IUT acts as specified in the Abstract Test Suites.



► Figure 12: Test Configurations I & II

¹² Tektronix, Protocol Tester: K1297, Conformance Tests for GPRS, C73000-M6076-C757-1, Test case description NS_B_N_003

¹³ Tektronix, Protocol Tester: K1297, Conformance Tests for GPRS, C73000-M6076-C757-1, Test case description NS_B_E_003