

# TESTING

USING TELECOMMUNICATIONS MANAGEMENT



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TELECOMMUNICATIONS SYSTEMS ARE EVOLVING EVER MORE QUICKLY. THE LIFE-CYCLES SHORTEN AND COMPLEXITY INCREASES. ONE MAJOR PROBLEM THREATENING THE EVOLUTION OF TELECOMMUNICATIONS SYSTEMS IS THE LACK OF ADEQUATE QUALITY ASSURANCE EQUIPMENT. THE GREAT COMPLEXITY OF THESE SYSTEMS REQUIRES INDEPENDENT TESTING OF SYSTEM COMPONENTS. HOWEVER, POPULAR TEST METHODS ARE NOT ABLE TO TEST ALL SYSTEM COMPONENTS EFFECTIVELY. MANY SYSTEM COMPONENTS HAVE PROVED TO BE HIGHLY INACCESSIBLE. THE CONCEPT DESCRIBED HERE IS DESIGNED TO IMPROVE THIS ACCESSIBILITY.

### What is testing?

Testing is a way to verify if an implementation behaves correctly. This involves testing of all valid behaviour as well as behaviour testing under critical and/or error conditions. Such tests are therefore major quality assurance instruments. The current trends of testing can be summarised as follows:

#### **Boundary Scan for hardware testing:**

To gain more insight into the quality of hardware systems the boundary scan concept was developed in 1990 and standardised by IEEE in 1149.1. This concept offers direct access in hardware testing and enables specific parts of complex digital hardware implementations (e.g. integrated circuits or printed circuit boards) to be observed and controlled.

#### **Automated software testing and in particular protocol conformance testing:**

In the early eighties, the ISO group JTC 1/SC21 started its study and standardisation of a number of aspects of protocol conformance testing. ISO published in 1991 the International Standard ISO 9646, describing several test methods and a test language. The appropriate test method for many practical test configurations is the 'remote test method'. This method owes its name to the fact that it uses only the physical communication interface between the test system and the System Under Test (SUT). Therefore, the method does not offer direct access to the protocol Implementation Under Test (IUT). In practice, the test system consists of an IUT tester, plus extensive software to control communication with the SUT on all lower protocol layers (see figure 1).

#### **Glassbox testing:**

Glassbox describes procedural processes to improve the quality, to shorten both costs and time to market of telecommunications systems. In this concept the testing activities are carried out by the manufacturers in their test centres to prove the quality of their implementations. Tests for interworking and integration purposes are executed at and by the manufacturer, as far as possible.



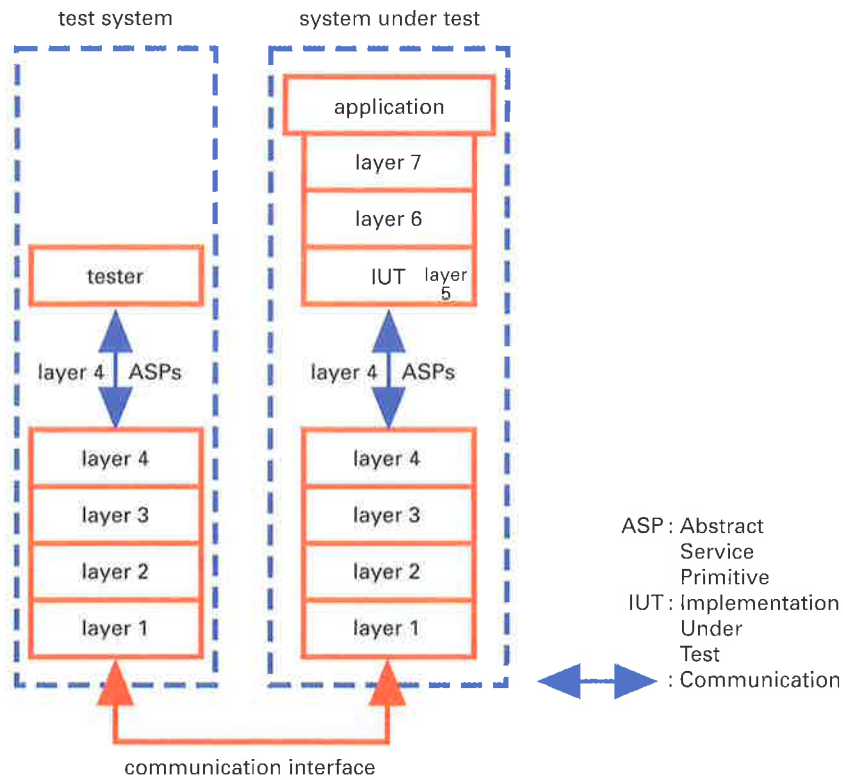


Figure 1.  
The ISO-9646  
remote test method.

### What is Telecommunications Management?

Many manufacturers of telecommunications management systems presently use their own non-standardised management interfaces. However, future management systems are likely to be based on standardised concepts; ITU-TS is developing the Telecommunications Management Network (TMN) concept. TMN is based on a layered management architecture consisting mainly of management systems that manage the network elements. Information exchange between them takes place via standardised interfaces. For these interfaces, the OSI management concept is used. I.e. OSI Management standardises the way in which management information can be exchanged between open systems.

### OSI Test Management Function:

To standardise the remote control of tests, the Test Management Function (ITU-TS Rec. X.745 | ISO/IEC 10164-12) has been defined. Among other things, a manager-agent test model has been defined. In this test model, the Operations System (Managing System) controls a test using a test conductor and the Network Element (Managed System) carries out the test using a test performer (see figure 2). Upon execution of a test, the test conductor directs a test request to the test performer. The test request indicates which managed object refers to the functionalities that have to be tested. This managed object is called a Managed Object Referring to Test (MORT). Also Associated Objects (AO) are defined. AOs represent managed objects that are also involved in the tests.

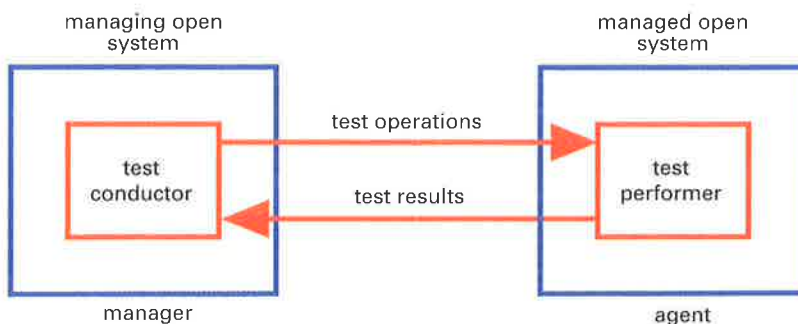


Figure 2.  
The manager -  
agent test model.

### Test Categories:

The generic Test Management Function applies to many kinds of tests. In a separate OSI Systems Management Function, the Confidence and Diagnostic Test Categories (ITU-TS Rec. X.737 | ISO/IEC 10164-14), test categories are defined. A Test Category specifies test characteristics and test management information for specific kinds of tests. One of them, the Resource Boundary Test Category, can be used for protocol conformance testing. This approach is in line with the ISO 9646 conceptual test method and with other test specification methods. Note that this category can also be used for other kinds of tests, e.g. interoperability (inter working) testing, distributed system (network) testing, testing in the operational phase, prototype testing and hardware testing.

### Why testing with OSI Management?

The ISO-9646 'remote test method', although frequently used in the field of conformance testing, is not very powerful, because it has no direct access to the IUT protocol. Each IUT is surrounded by other protocols that prevent full control and observation of the IUT. The shortcomings of the remote test method lead to the following problems:

- Testing is expensive, because complex test equipment is needed;
- Testing is time-consuming in relation to the time required for specification and implementation;
- Testing does not create real confidence in the SUT, because the test coverage is low.

To solve these problems, direct access to the separate protocol (sub)layers is absolutely vital. Only by direct access cheaper generic test systems can be created and a shorter testing phase can be achieved. ISO 9646 defines the 'conceptual' test method (see figure 3). In the conceptual test method, the protocol layer can be controlled and observed on its boundary, where communication between the protocol layers takes place. The points on the protocol boundaries are called the Points of Control and Observation (PCO).

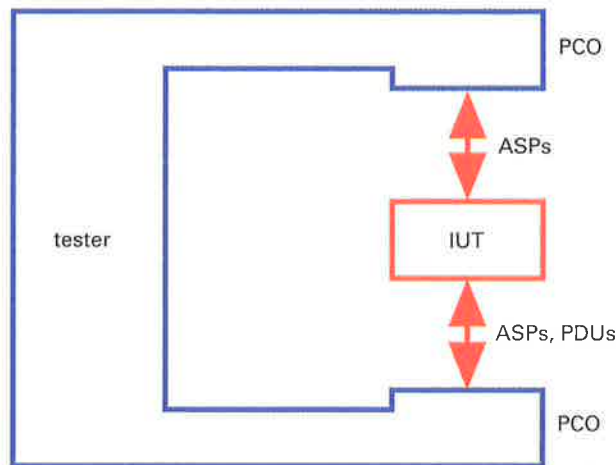


Figure 3.  
The ISO-9646  
conceptual test  
method.

The Conceptual Test Method requires an external interface to obtain direct access to the protocol layers. Most large telecommunications systems have an external interface for management purposes. In the future the management interfaces of many large telecommunications systems will be based on OSI management. A logical step was the decision to use the management interface to perform protocol conformance tests. The advantages can be summarised as follows:

- The costs for test equipment decrease;
- The test description and execution time shorten;
- The test coverage increases;
- The standardised management interface can be used as the external test interface;
- Application of this concept can increase the practicability of Glassbox testing.

## How testing with OSI Management?

The Resource Boundary Test Category, as mentioned earlier, can be applied for protocol conformance testing as follows:

- The Resource Boundary Test Category contains definitions of the relevant management information needed for testing protocol layers or parts of a protocol layer. In management information models using this test category the MORT has a strong relation with the IUT. And the AOs are related to the corresponding PCOs of the IUT. Figure 4 shows the test model when the Resource Boundary Test Category is applied for protocol conformance testing.
- TMN can also be a base for other kinds of tests, e.g. interoperability testing. A managing system will then function as the test system and the NEs that are managed will function as SUTs.

In order to achieve all this, future management information models should include those aspects that should be tested in a later phase. I.e. PCOs should be defined at the boundaries of a protocol layer.

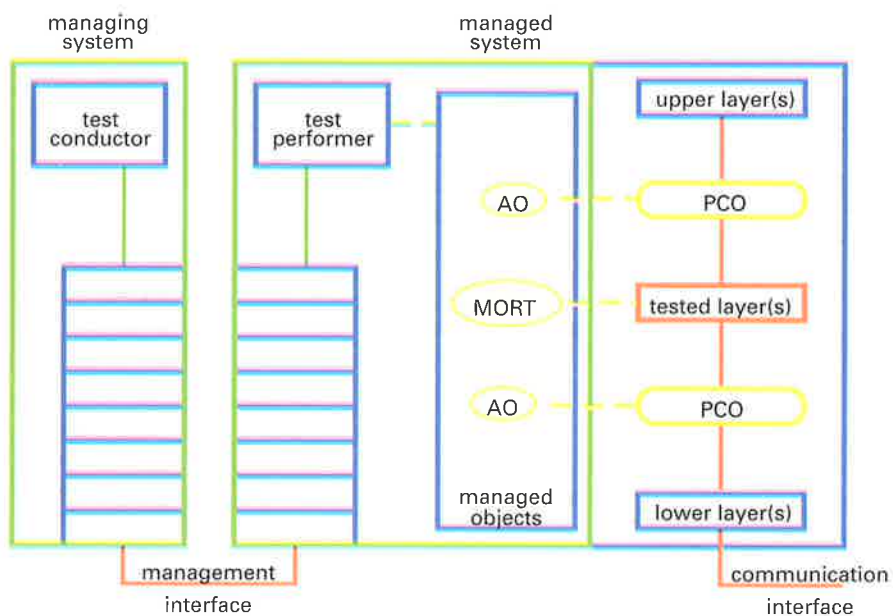


Figure 4. Protocol conformance testing using the Resource Boundary Test Category.

AO: Associated Object  
MORT: Managed Object Referring to Test  
PCO: Point of Control and Observation

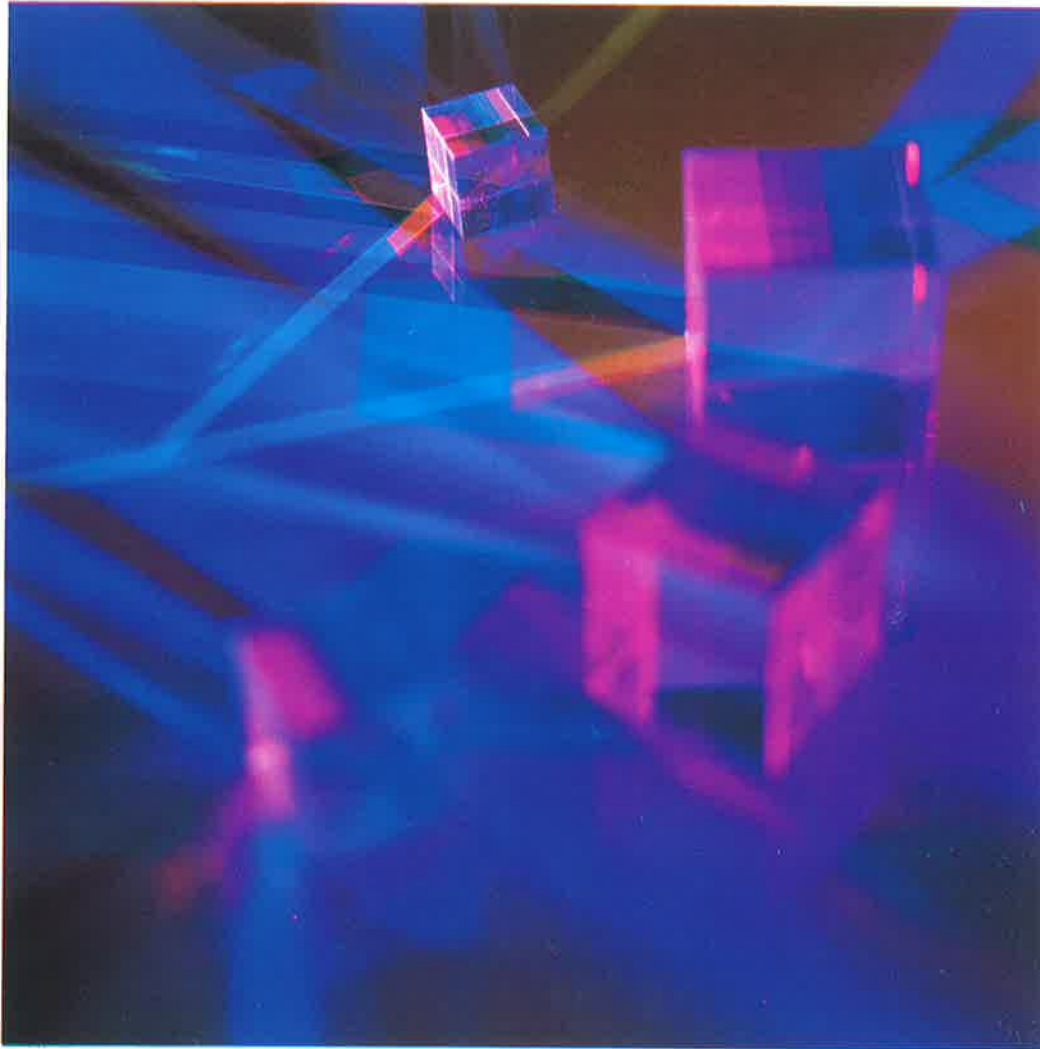
## Summary

The difficulties associated with testing telecommunications software reach unacceptable levels due to increasing system complexity. Existing test methods are not powerful enough to test the systems efficiently. Therefore a new test technique has been developed, that provides direct access to the various system components to be tested. The test system will use OSI Management and the management interface to execute and control the tests within the System Under Test. The Resource Boundary Test provides the user with a means to test parts of a system separately as if they were not encapsulated in the system. This type of test is very suitable for resources that have complex behaviour and cannot (completely) be tested by observing external communication interfaces.

With the application of the Resource Boundary Test

Category it will be possible to test the protocols much cheaper and quicker. Especially the test coverage will be higher.

To control the process of testing in all phases of the life cycle, from prototype testing until operational testing, Glassbox procedures can be used. In this way both the manufacturer and the customer have a better view of the quality of the tested systems.



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