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SERIES M: TELECOMMUNICATION MANAGEMENT,
INCLUDING TMN AND NETWORK MAINTENANCE

Integrated services digital networks

**Overview of an automated service test to
support cost-efficient telecom service
assurance**

Recommendation ITU-T M.3710



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Recommendation ITU-T M.3710

Overview of an automated service test to support cost-efficient telecom service assurance

Summary

Recommendation ITU-T M.3710 provides an overview of an automated service test. It defines a general model for an automated service test and describes a set of functional requirements to support cost-efficient telecom service assurance.

History

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T M.3710

Overview of an automated service test to support cost-efficient telecom service assurance

1 Scope

This Recommendation provides an overview of an automated service test. It defines a general model for an automated service test and describes a set of functional requirements to support operators carrying out a customer-oriented telecom service test.

The measurement parameters to be monitored for specific services are outside of the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T E.800] Recommendation ITU-T E.800 (2008), *Definitions of terms related to quality of service.*
- [ITU-T M.3050.1] Recommendation ITU-T M.3050.1 (2007), *Enhanced Telecom Operations Map (eTOM) –The business process framework.*
- [ITU-T M.3320] Recommendation ITU-T M.3320 (1997), *Management requirements framework for the TMN X-interface.*
- [ITU-T Q.3945] Recommendation ITU-T Q.3945 (2011), *Test specifications for next generation network services on model networks – Test set 1.*
- [ITU-T X.733] Recommendation ITU-T X.733 (1992) | ISO/IEC 10164-4:1992 , *Information technology – Open Systems Interconnection – Systems Management: Alarm reporting function.*
- [ITU-T X.745] Recommendation ITU-T X.745 (1993), *Information technology – Open Systems Interconnection – Systems Management: Test Management function.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 network operator [ITU-T M.3320]: An organization which operates a telecommunications network. A network operator may be a service provider and vice versa. A network operator may or may not provide particular telecommunications services.

3.1.2 quality of service (QoS) [ITU-T E.800]: Totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service.

3.1.3 service [ITU-T M.3050.1]: Services are developed by a service provider for sale within products. The same service may be included in multiple products, packaged differently, with different pricing, etc.

3.1.4 service provider [ITU-T M.3320]: A general reference to an entity that provides telecommunications services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider.

3.1.5 test operations [ITU-T X.745]: Management operations concerned with tests.

3.1.6 test performer [ITU-T X.745]: An agent which receives test operations.

3.1.7 test request [ITU-T X.745]: An individual request issued by a test conductor to a test performer, in order to initiate one or more test invocations.

3.1.8 test results [ITU-T X.745]: Information generated during test execution and made available to an open system.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 test point: The function entity that takes the role of test performer and interacts with the telecom network.

3.2.2 test domain: A set of test points that share some common characteristics and are subject to unified management.

3.2.3 test programme: A test plan and an assembly of attributes to accomplish a specific test objective.

3.2.4 test script: A service-specific software unit that can perform the test operations of a particular service automatically.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BSS	Business Support System
eTOM	enhanced Telecom Operations Map
MDN	Mobile Directory Number
NO	Network Operator
NTP	Network Time Protocol
OSS	Operation Support System
QoS	Quality of Service
SLA	Service Level Agreements
SP	Service Provider

5 Conventions

The following conventions are used in this Recommendation:

- The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

- The keywords "**is prohibited from**" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.
- The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.
- The keywords "**is not recommended**" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation can still be claimed even if this requirement is present.
- The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 Concepts and background

6.1 Overview

Providing high quality telecom services to end users in a cost-efficient manner is the key for a NO/SP aiming to gain a sustainable competitive advantage. The NO/SP needs to ensure that services delivered to customers are continuously available and meet the requirements of SLA or QoS levels. At the same time, reducing the operating costs and increasing operation efficiency is another important consideration for telecom operators.

The automated service test is a solution for end-to-end service quality assurance that uses an automated test facility which can proactively search for network failure and/or service quality deterioration. Appendix I describes some examples of automated service test scenarios. The automated service test is able to ensure the quality of a wide range of telecom services such as voice services, messaging services, data services, value-added services, etc. Appendix II describes some use-cases of the automated service test.

6.2 Position in the eTOM business process framework

Figure 1 illustrates the position of the automated service test in the eTOM business process framework [ITU-T M.3050.1]. The automated service test is an element of the assurance operations process, which supports service problem management and service quality management of the service management and operations function.

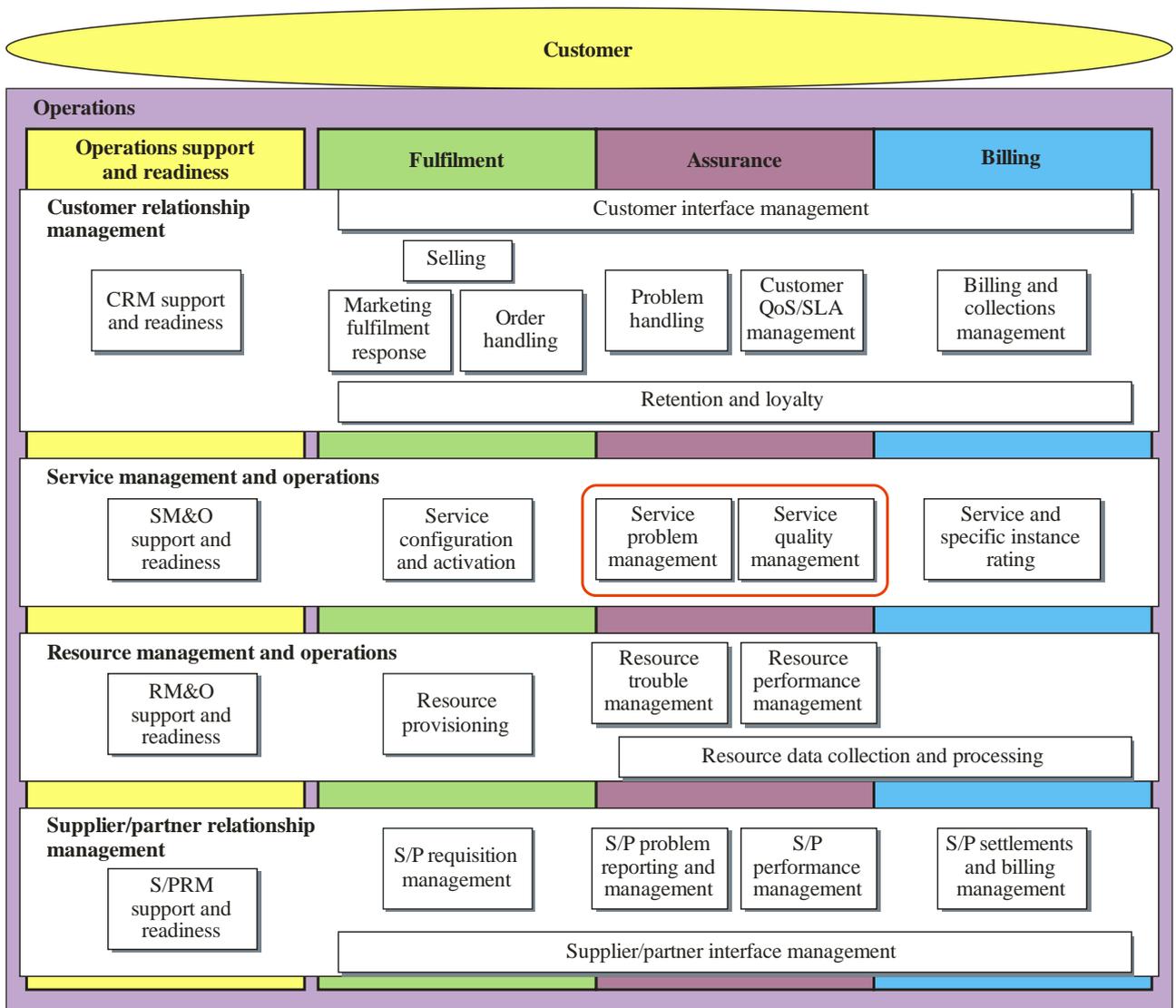


Figure 1 – Position of automated service test in eTOM framework

6.3 System and entity relationship in this Recommendation

As indicated in Figure 2, the systems and entities involved in the automated service test include BSS/OSS, the test manager, test points and telecom networks.

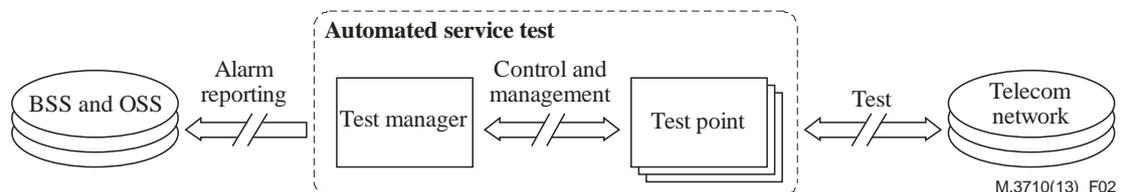


Figure 2 – Systems and entities involved in automated service test

This Recommendation describes the management functions between the test manager and test points and the management functions between the test manager and BSS/OSS. The test interface between test points and the telecom networks should comply with the standardized network interface protocols. The corresponding function requirements are outside of the scope of this Recommendation.

7 General model of the automated service test

Figure 3 illustrates the model of the automated service test, which is principally comprised of the test manager and test points. The automated service test is controlled by test programmes defined by the test manager. Test points receive test requests from the test programme and invoke test scripts to perform service test operations.

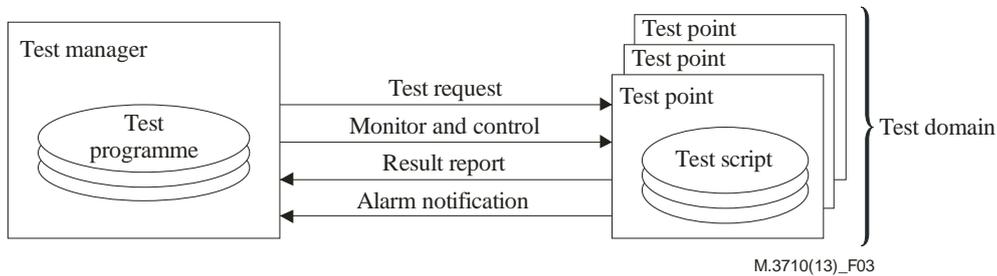


Figure 3 – Model of the automated service test

- Test manager: The entity which controls and manages all the service test operations. The test manager can create and manage multiple test programme instances.
- Test programme: A test plan and an assembly of attributes to accomplish a specific test objective. A test programme can be instantiated from a test template, which can facilitate the effectively automated service test.
- Test point: The function entity that assumes the role of test performer. Test points can send and receive signals and interact with telecom networks. Figure 4 shows the typical structure of a telecom network for service testing (referenced from [ITU-T Q.3945]). Although test points can be deployed in any of the control points of Figure 4, test points are typically deployed at the UNIs of the network.

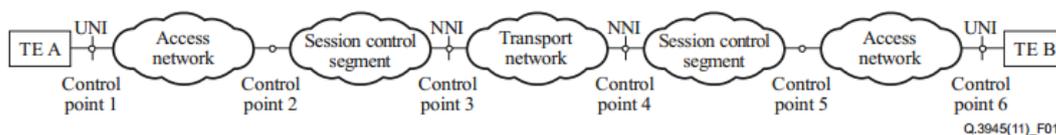


Figure 4 – The structure of a typical model network for service testing

- Test script: A service-specific software unit that can be invoked by a test programme and perform the test operations automatically.
- Test domain: A set of test points that share some common management features, for example, they may belong to the same geographical area or administrative zone, or they may use the same interface protocol, or apply the same test policy, etc. Test points in the same test domain can be managed in the same way.

8 Functional requirements for an automated service test

8.1 Programme template management

The programme template describes the common components of a test programme and helps in facilitating the quick and easy setup of a test programme.

The general test programme template is required to include the following basic information:

- Test programme ID: The unique identifier of the test programme.
- Test programme name: Name assigned to the test programme.
- Description: Brief introduction of the test programme.

- Priority: Priority value controls the sequence in which concurrent test programmes need to be conducted so that any test resource requirement conflicts can be avoided. Test programmes with higher priority should be served first.
- Invocation cycle: Invocation cycle controls the time and frequency for the execution of a test programme. A test programme can be executed in both periodic and aperiodic ways.
- Report interval: The time interval for a test point to submit the test result and test data.
- Test item list: Number of test tasks that should be executed automatically in a predefined sequence by the test programme. The execution of each test item should invoke the corresponding test scripts to perform test operations on a specific service.
- Test domain and test point lists: Assignment of test domain and a list of test points which should perform this test.
- Resource: Physical and logical resources allotted for the test programme.

It is required to allow the test manager to create, modify, interrogate or delete a programme template.

8.2 Test programme management

Test programme management is required to consist in the following:

- The ability to create a test programme by instantiating the test programme template.
- The ability to configure a test programme based on the service test objective. The invocation cycle and the range of test points involved in the test should be designed carefully, so as to minimize the impact on the normal network traffic and service usage.
- Test manager support to activate, inquire, suspend, modify, reactivate, terminate and delete the programmes. The corresponding status of a test programme can refer to test states defined in [ITU-T X.745].
- The ability to allow a test manager to centrally manage all test programmes. The test manager maintains the queues of all activated test programmes and starts test sessions with corresponding test points according to the time cycle assignment and the priority of test programmes.
- The ability to allow a test manager to monitor and control the execution of the service test in each test point.

8.3 Test point management

Test point management is required to consist in the following:

- Configuring the network interface protocol of test points.
- Monitoring the state of all test points.
- Collecting test results and test data from test points periodically or by request.
- The test point is recommended to be able to store test data locally for a long enough period of time when test data are, for any reason, unable to be submitted to the test manager.
- All test points are required to be time synchronized based on the Network Time protocol.

8.4 Test script management

As there is significant diversity for different telecom services in service function and service process, a test script should be specifically designed for each type of service. Test scripts can be developed via a programming language or script/notation language, which is outside of the scope of this Recommendation. The management of test scripts consists of the following:

- Test scripts are recommended to be downloaded, installed, updated or deleted by test points upon request from the test manager, either locally or remotely.
- Service parameters are recommended to be monitored and captured during the service test. The parameters to be captured for a specific service can optionally refer to ITU-T Q-series and ITU-T E-series Recommendations.

All test operations are required to comply with the network interface, signalling and service protocols of the tested network and service and should not introduce unintended service failure or un-conformance.

8.5 Test resource management

Test resources consist of logical and physical resources necessary for performing an automated service test, for example, telephone number, IP address, test cards, test terminals and other instruments, etc.

- All test resources are recommended to be centrally controlled by a test manager. The test manager should be able to manage the readiness and availability of all test resources.
- A test manager is required to be able to add, remove, activate, test and allocate all test resources. Only resources allocated by the test manager can be accessed and utilized by a corresponding test programme.
- A test manager is recommended to support priority-based resource scheduling, so as to satisfy the resource requirements of high-priority test programmes and harmonize the conflicts among different test programmes.
- A test manager can optionally support the discovery and force release of test resources when it is occupied by the hung test programmes.
- A test resource can optionally be multiplexed by different test programmes/test points on the basis of a time schedule.

8.6 Test data management

Test data management should support the further processing and analysis of test results and test data reported from test points, in order to find potential service problems in time, supervise the service quality and acquire information that can assist O&M staff to locate and resolve problems.

Test data can be comprised from two parts. The first part of test data is test programme specific data that can reflect the process of how test programmes are scheduled and executed. The following data are required to be collected:

- The point in time to start each test programme execution.
- The point in time to stop each test programme execution.
- The process of the programme that is scheduled.
- The process and result of test resource allocation.
- The result of programme execution: the success or failure of each test programme execution and the corresponding fault code or reasons if the test has failed.

The second part of test data is service specific parameters that record the service flow and the critical service parameters that can help in analysis of the service quality. The following data is required to be collected:

- The point in time to start the test of a specific service.
- The point in time to stop the test of a specific service.
- The process and result of a test resource invocation.
- The outcome of the test: the result of a specific service test, which can optionally refer to the test outcome definition of [ITU-T X.745]. The corresponding fault code or reasons for failure can optionally be provided when a service failure occurs.
- Service parameters: critical service dependent parameters that are captured during the service test.

A test point can optionally report test results and test data to a test manager via the following methods:

- Immediate: test points report test result/test data as soon as possible after the execution of the test in the case of the real-time service monitoring and service quality analysis.
- Periodic: test points report test result/test data in the predefined time and period in the case of routine service quality monitoring and assurance.
- By request: test point reports test result/test data whenever it receives the request from the test manager.

It is recommended that all the test data reported from test points should be stored in the test database.

The test manager is recommended to be able to process the test result and test data, calculate the service KQIs and verify end-to-end service QoS and its change trend.

The basic classification of service quality metrics can optionally refer to the service quality characteristics of [ITU-T E.800] and particular service metrics definition and calculation can optionally refer to corresponding E series and Q series ITU-T Recommendations.

The test manager can optionally conduct correlated analysis based on the test database, so as to identify possible service faults and to indicate the severity, affected area and fault location when network/service failure or quality deterioration occurs.

The result analysis can optionally be presented in a graphical manner, visualizing the service status of test points, test domains and the overall network and service and indicating the area and the severity when network/service problems occur.

8.7 Alarm notification

Alarm management is an important function of real-time notification to the OSS/BSS and O&M staff of service problems that are found during the automated service test.

- Alarm definition support. An alarm is recommended to include the following information: alarm title, alarm severity, alarm type, alarm content that explains the reason for raising the alarm, the point in time when the alarm is raised, test point/test programme ID and alarm trigger criteria. The alarm severity is recommended to comply with the definition of [ITU-T X.733].
- The ability to configure the alarm trigger criteria or alarm policy for each test programme and the following conditions can be optionally supported when defining the alarm policy:
 - Specific service quality metric is above or below the predefined threshold.
 - The duration of service quality downgrading is detected.
 - The trend of service quality indicates possible network/service failure or deterioration.

- A test point is required to detect and raise an alarm in time when there is an occurrence of network and service unavailability. The test manager should forward alarms from test points to OSS/BSS and O&M staff.
- The test manager is required to analyse and find possible service quality problems and forward alarms to OSS/BSS and O&M staff in time.
- The test manager can optionally support the ability to assign the alarm forwarding destination and the real-time alarm notification in multiple forms including generating sounds or sending an SMS or e-mail.
- It is recommended to support the alarm operations including alarm enquiry, alarm clearing and alarm backup.

8.8 Security consideration

It is recommended that the following security mechanisms should be implemented:

- To allow only authorized users to access the automated service test facilities.
- To allow only authorized users to operate test programmes and access test results and test data.
- To allow only authorized test points to access the allocated test resources.

Appendix I

Example of automated service test scenarios

(This appendix does not form an integral part of this Recommendation.)

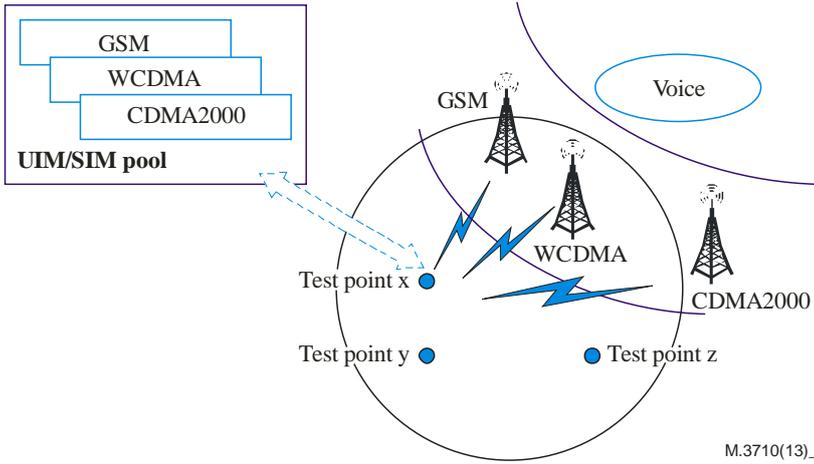
I.1 Scenario 1 of automated service test

Legend	Scenario
Scenario title	Automated roaming test
Service Requirements	To ensure all frequently used mobile services work reliably both inside and outside of the home network, so that subscribers can access and use mobile services anywhere with the committed quality wherever the subscriber is roaming both home and abroad.
Scenario description	<ol style="list-style-type: none"> 1. Assuming that the following inbound roaming into City a of Country A should be tested: roaming from City b and City c of Country A to City a of Country A, and roaming from City d of Country B to City a of Country A. 2. Test points x, y, z had been deployed in City a of Country A, and all deployed test points should have downloaded the predefined test scripts. 3. After the test programme is activated (by request or via a predefined trigger event), test points should retrieve the user data from the SIM/UIM resource pool whose home location is City b and start the test operations under the control of test scripts which can carry out the test for frequently used mobile services such as voice communication, SMS, Internet surfing, etc. 4. Next, test points should then retrieve the user data from the SIM/UIM resource pool whose home location is City c and City d and then each test point should start the test alternately. 5. An alarm should be issued to the test manager and forwarded to BSS/OSS and O&M staff if consecutive test failures are found. 6. The test manager can suspend or terminate the test by sending a request to the test points during the course of the test. 7. After the test is completed or terminated, test results and test data should be collected by the test manager for further analysis.
Figure describing the scenario	<p style="text-align: center;">Figure I.1 – Automated roaming test</p>

Legend	Scenario
Derived function requirements	<ol style="list-style-type: none"> 1. Service programme management, including the synchronization of test scripts to test points, the activation, suspension and/or termination of the service programme. 2. Test resource management, including the SIM/UIM information multiplexing. 3. Test point management for conducting the test operations. 4. An alarm should be issued and a test report should be collected and analysed.

I.2 Scenario 2 of automated service test

Legend	Scenario
Scenario title	Benchmarking test
Service Requirements	In the competitive telecommunications environment, telecom operators need to acquire knowledge of the network performance and service quality of their competitors. Telecom operators also need to assess the situation of their own service delivery so that network/service optimization can be carried out and so that decisions can be taken on marketing policy.
Scenario description	<ol style="list-style-type: none"> 1. Assuming that telecom operator A is running a CDMA2000 network, telecom operator B is running a WCDMA network and that telecom operator C is running a GSM network. Telecom operator A needs to benchmark its voice service with the other two telecom operators (B and C). 2. Test points that support the GSM/CDMA2000/WCDMA air interface protocol are deployed. 3. The test manager specifies the test programme and the test resources that are required. 4. Test points download the predefined test scripts, retrieve the use data (UIM/SIM information) and consecutively and/or simultaneously carry the test calls through the GSM, CDMA2000, WCDMA networks. 5. Test data that can record the critical parameters and service flow of the test are collected. Test points periodically submit the test data to the test conductor. 6. The test manager collects the test data and calculates the service metrics for the voice call of different networks/operators, such as "Establish Duration", "Alert Duration", "Call Success Rate", etc. 7. If the service metrics are above/below predefined thresholds, an alarm should be raised and forwarded to BSS/OSS and O&M staff. 8. The KPIs and other analysis results are presented as a visual report and submitted to O&M staff and marketing staff for further use.

Legend	Scenario
<p>High level figure describing the scenario</p>	 <p style="text-align: center;">Figure I.2 – Benchmarking test</p>
<p>Derived function requirements</p>	<ol style="list-style-type: none"> 1. Service programme management including the synchronization of test scripts to test points and the activation, suspension and/or termination of the service programme. 2. Test scripts should comply with the interface protocols and service processes of multiple networks. 3. Test data collection and service quality analysis.

Appendix II

Use cases of automated service tests

(This appendix does not form an integral part of this Recommendation.)

Use cases of automated service tests include but are not limited to:

- Service quality supervision: perform 24/7 uninterrupted testing of network and service quality. The service quality characteristics are described in [ITU-T E.800].
- Upgrade/rollout support: perform extensive testing before and after the installation or modification of network infrastructure or a new service rollout, so as to ensure a smooth upgrade and rollout and minimize the impact on the service user.
- Fault location: identify the range affected when a network failure or service quality downgrade occurs and assist in quickly locating the problems by providing an extensive test.
- Benchmarking: Operators need to benchmark their network and services against the competition via automated and continuous testing and measuring of corresponding service KPIs of different operators and find ways to surpass their competitors in terms of network and service quality.

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