

Multi-device STB Testing Using Round-Robin Method

INTRODUCTION

Mass production nowadays entails the need for accelerated testing of product's quality, giving rise to automation of testing processes, and especially in production of software and hardware.

Automation of set-top-box testing can be a huge investment in terms of procurement of testing equipment. On the other hand, inefficient and time-consuming manual testing is even more expensive due to high probability of human error. This results in deployment of relatively unreliable devices with potentially high failure rate which will eventually be returned to the manufacturer, repairer or operator thus increasing the overall cost of product positioning (transport, services, etc.). Statistical data related to this problem are devastating and show that almost 10% of the units returned to operator and service center are not extensively tested, and about 40% of the total number of returned units don't have failure and perform correctly. It is therefore necessary to have a system which performs automated testing in the most efficient way and accordingly increase the reliability of the supplied product.

AUTOMATED TEST SYSTEM

Automated test system (ATS) is a stand-alone test environment for automated testing of STB. ATS provides execution of big test loads with minimum engagement of testers. Like all systems intended for black-box testing, it tests a device regardless of its internal logic, thus assessing:

- Functionality
- Stability
- Robustness
- Reliability
- Performance and
- Behavior of a device after a long-term stress test.

ATS FOR TESTING WITH "ROUND-ROBIN" METHOD

One method for automated testing of a number of set-top boxes is called "round-robin". Testing with this method significantly reduces the time and effort required to test each device individually. The method is very useful not only for digital TV operators, but also in other arenas, ranging from R&D and QA departments, through to service centers.

ATS consists of two 19" racks foreseen for testing of up to 24 devices. It represents a common platform for testing of DVB-C, DVB-T, DVB-S and IPTV STB. It contains:

- 2 RT-AV100 grabber units

- 6 controllable switchers (HDMI, CVBS, S / PDIF, analog audio) controlled from a PC application either through LAN or serial connection
- LAN switch - provides network connectivity to RT-AV100 devices and switchers
- 2 IR blasters RT-IR016U simultaneously sending IR commands to 16 exits.
- PC with the control application



ATS for STB testing with "round-robin" method

Output interfaces of the tested set-top-boxes are connected to the inputs of controllable switchers. On the other end, signal from the switchers' outputs are fed to the input interfaces of the RT-AV100 units.

RC emulators which are placed directly in front of each STB are connected to RT-IR016U blasters, which are controlled by the PC application via USB connection.

Upon launching the application and loading the desired test plan, along with the tests, files that define test environment and configuration of all in-test-deployed devices are also loaded. The tests describe a scenario defining tested functionalities, i.e. operations that will be executed during the test (by both physical and logical devices).

Since RTAV100 can acquire output data from only one tested device at a time, the system calls set-top-boxes in consecutive order. The scheduling is resolved using the aforementioned switchers managed from the PC (RT-Executor) application.

TESTING

In general, the scenario of testing in this environment is as follows: ATS sends IR commands to each of 24 STB devices using RT-IR016U. After all devices under test are brought into a desired state, the procedure continues with "polling" of each consecutive DUT. This action begins with selection of corresponding inputs on switchers, then, depending on the requirements of the test, either image or audio sequences are grabbed by the RT-AV100 device. RT-AV100 sends the captured files (images, audio) to the PC over LAN, where processing and analysis of the files are performed using pre-defined algorithms.

In addition to standard comparison algorithms (Peak Signal-to-Noise Ratio, RT-RK proprietary algorithms, Audio Comparison) an algorithm for OCR (Optical Character Recognition) is also available, allowing reading of on screen content.

For a standard STB with HDMI, S/PDIF and SCART outputs, ATS needs about 60 seconds to check interfaces (digital audio and video on HDMI, digital audio on S/PDIF, and analog video and audio on SCART connector), grab image or audio, analyze, compare with referent values and report results of the comparisons.

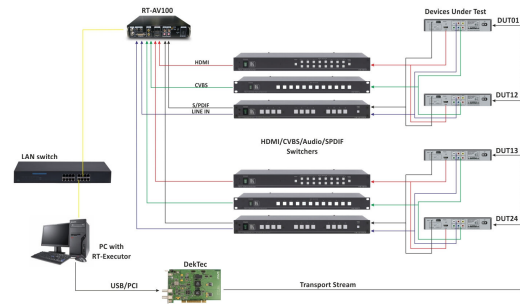
Aside from testing interfaces, i.e. checks on presence of the output signal, the system is used to test:

- GUI, RC (zapping time, menus, OSD messages, EPG)
- Video (resolutions, video formats...)
- Audio (audio formats, volume level adjustment...)
- Tuning / scanning
- Teletext, subtitle
- Performance (aspect ratio...)
- LAN (LAN status)

There are two methods of testing with this system. The first method involves comparison of grabbed image or audio sequences with predefined referent values (golden reference). Another method is to use a referent unit (golden device); its purpose being to perform simultaneously along with a tested unit, and provide "live" references for the device under test.

TESTING WITH "GOLDEN REFERENCE" METHOD

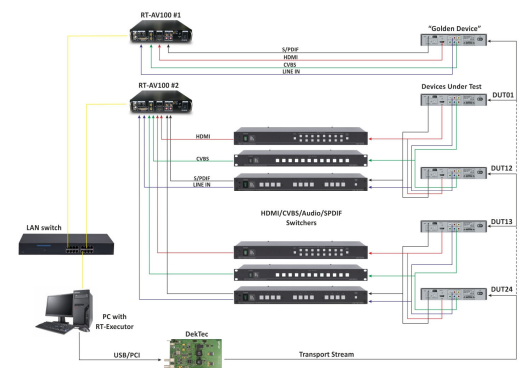
Testing with "golden reference" method requires carrying out so-called preliminary testing/grabbing. Thus obtained image and audio sequences are further considered references. The same procedure can be repeated during the testing process, if necessary, in order to revise the referent files if there is a change in the STB software. The procedure of obtaining/re-declaring references is fully automated.



Schematic of ATS environment for testing with "golden reference" method

TESTING WITH "GOLDEN DEVICE" METHOD

When using a golden device, referent files are created during a test. Namely, in this case grabbed image and audio sequences obtained from the referent device are automatically assigned references during the test execution. As such, they are used for further analysis and evaluation of image and audio outputs of the tested devices.



Schematic of ATS environment for testing with "golden device" method

When testing with a golden-device it is possible to check the behavior of a device under test using dynamic streams. Challenging synchronization issues of the two streams, ATS resolves by seeking for the best consecutive match of grabbed outputs from the referent unit and the unit under test. After two such frames are found, the procedure continues with comparison of the remaining frames.

REPORTING

Detailed reporting on the executed tests provides an insight into the overall course of execution, as well as potentially detected errors. In addition to physical and logical devices, ATS may include various 3rd party modules (such as bug tracking systems), and it is possible to administer the errors to one of the supported (Bugzilla, Mantis, ClearQuest).



USE CASE

The main use case of ATS system is automated testing of set-top-boxes at digital TV operators'. This is primarily to support:

- Acceptance testing – testing of new STB units for the customer base
- Functional testing – testing/diagnostic of returned used units, for repair, or from users who terminated their subscribers contracts.

Depending on the type of testing, ATS executes predefined test plans. Except for digital TV operators, the system proved to be useful in other phases of STB life cycle:

- Research and Development departments
- Quality Assurance departments
- Service Centers

EFFICIENCY

ATS was developed to respond to the challenge of supporting an adequate throughput of testing a larger number of STB units. It performs automatic tests that cover all functionalities of multiples of units of the same or even different models (even of different manufacturers) in parallel.

The advantage of ATS testing primarily lies in reduction of the time required for testing, and therefore the cost of testing. In addition, such an efficient environment executing large number of tests with minimum human engagement increases reliability of the tested devices.

FEATURES

- Use case: multi-device STB testing using referent files or referent device
- Suitable for TV operators, R&D, Q&A, service centers
- Reduced time spent on repetitive testing
- Reduces potential for tester error
- Common platform for Cable, Satellite, Terrestrial and IPTV receiver device testing
- Powerful AV analysis, and enhanced Optical Character Recognition (OCR)
- Efficient scripting of documented and repeatable tests (Python based scripting)
- Detailed reporting and fault diagnosis aid QA verification
- Results available over LAN
- Modular, expandable and scalable solution to cater various deployments
- Simple integration with 3rd party modules, like bug tracking systems

PACKAGE

CD with:

- SW installation and documentation
- RT EXECUTOR test control and development software

HASP key

Hardware components:

- 2 RT-AV100 grabber devices
- 2 HDMI switchers - 16 ports each
- 2 CVBS switchers - 12 ports each
- 2 analog audio and S/PDIF switchers - 12 ports each
- LAN switch
- 2 RT-IR016U devices + 26 RC emulators
- Workstation (PC) *
- DekTec DTA-115/DTA-107 Card*

**optional*

SERVICE

- The system is delivered fully assembled (committed cabling - HDMI, analog video and audio, S/PDIF coaxial, power cables, LAN cables for RT-AV100 devices and switchers)
- LAN cables for the STB not set.
- To complete the system, the user should set and connect STB units.