

BOOSTING MHP INTEROPERABILITY AND MHP MARKET STRENGTH THROUGH ADVANCED CONFORMANCE TESTING

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ABSTRACT

Alongside the MHP standard, DVB has established a conformance testing regime for receivers to give application and service developers a consistent target platform across different software implementations. The first test suite for MHP version 1.0.2 was released in Oct 02 and updated in Jan 03. One of the main contributors besides SUN to this test suite was a consortium of implementers known as the "MHP Test Consortium".

Strengthening this Test Suite based on practical experience of problems from early market deployment and updating it to newer MHP standards is the primary focus of the project MHP-CONFIDENCE (1) which is funded by the European Commission under the IST FP-6 framework. The partners in the MHP-CONFIDENCE project are the same as the members of the MHP Test Consortium.

INTRODUCTION

In 2000 the DVB project published the first version of its MHP ("Multimedia Home Platform") specification – ETSI TS 101 812 (2). This defines the interface between a digital TV receiver and the network from which it receives interactive TV applications. One of the commercial requirements for this specification was to enable independent implementations of the software in the receiver and in the network. It was recognised early on that a receiver conformance test suite was a necessary element in achieving inter-operability of applications between these independent implementations.

The MHP test suite builds on the vast experience of the conformance testing of Java implementations. The conformance tests for the Java part of MHP are re-used from Java specifications used outside the digital TV market. The overall methodology and operational model are also largely re-used from the way Java conformance testing operates.

CONFORMANCE TEST DEVELOPMENT

Assertions

The first step in developing conformance tests has been the creation of what are called "assertions". These are the smallest granularity of statements which should or could be tested. They consist of a textual description of the statement together with references to the parts of the specification from which the description is derived. The latter is important when the test suite is used since it enables objective discussion about the validity (or otherwise) of the assertion.

For a new specification, assertion development often identifies a number of issues not noticed by the original authors of the document. The issues identified during the development of the assertions for the MHP 1.0 series of specifications made a major contributor to the quality and maturity of that specification.

Test Strategies

Once assertions have been identified, the next step is to determine if the assertion is testable and if so, the strategy for testing it. There are a number of elements to this. First the pre-condition for the assertion must be created. Many assertions are only applicable when specific conditions apply. If there is no standard way of creating those pre-conditions then there can be no test strategy for the assertion and the assertion will not be testable. Many assertions will require that a specific condition causes a specific response. If there is no standard way of detecting the response then there can be no test strategy for the assertion and the assertion will not be testable. Additionally some assertions may relate to optional behaviour and need to be identified as such.

Test Applications

There is a one to one relationship from test applications to assertions. All test applications include a very simple MHP application which implements the test strategy of the assertion. They perform the necessary actions to set-up the pre-conditions, trigger the behaviour to be tested and check for the correct response. Test applications may also include DVB transport streams. For example, tests relating to the retrieval of DVB-SI information will need a stream containing the information to be retrieved. Some tests are more complex than this, for instance those relating to testing of tuning, testing the return channel or testing responses to changing conditions in a broadcast.

Since a single Java API may have hundreds of these test applications, review of tests for a number of Java APIs is very difficult. The approach taken has been to run the tests on implementations. Tests which pass on enough implementations are considered to be accepted. Tests which fail on all implementations are sent back to the supplier for re-working. There is also of course a middle group of tests which pass on some implementations but not on others where detailed investigation is needed. [mention developer <-> tester, mention this is main topic ?]

Test Automation

Running hundreds or thousands of tests manually is simply impractical. Some form of automation is required to make running these practical. The project uses an automated test environment based on a version of the "tetware" package (3) extended to include support for the playback of DVB transport streams and access to the return channel. Other automated test environments used with Java include Sun's "JavaTest" (4) and "JUnit" (5). These are not known to have been extended to include DVB transport stream playback.

Figure 1 shows how a MHP receiver “device under test” integrates with the other components of the automated test environment.

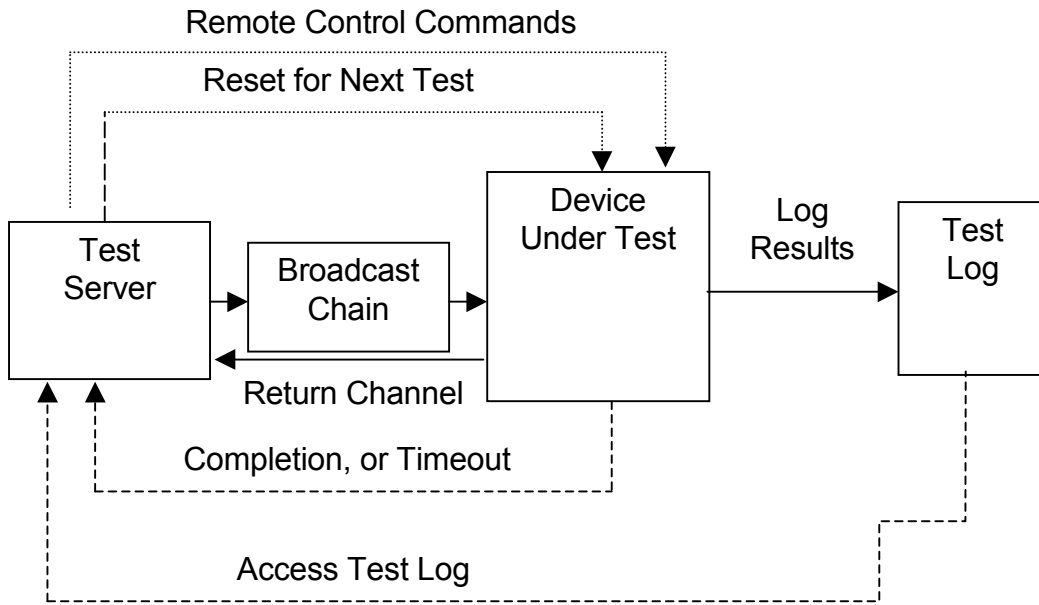


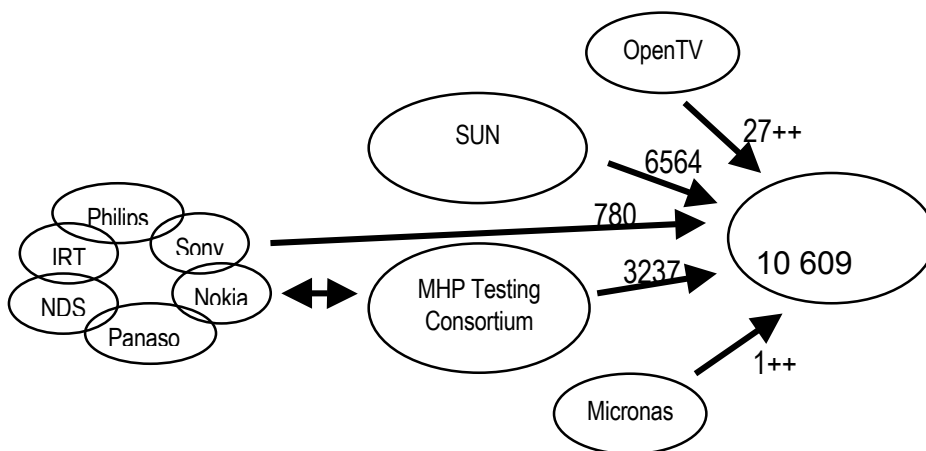
Figure 1 – Block diagram of automated test environment

With a system like this, many thousands of tests can be run without human intervention. Of course user interface tests often require visual inspection. This can be done either when the tests are run or can be done later if the automated test environment includes a mechanism to capture the visual output of the device under test and store it on the test server together with the test log.

PRACTICAL EXPERIENCE

The First Test Suite

The first MHP test suite was assembled in 2002 from a number of responses to a request for technology rather than as a single software engineering project. It was updated later in 2002 and early in 2003 to fill some known gaps in the first release. The Figure 2 shows the various contributions and the number of tests in each contribution.



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Figure 2 – Contributing parties and number of tests for first Test Suite

Ways for improvement

In 2003 and early 2004, the project consulted with MHP application developers to understand the inter-operability problems they were experiencing between receivers which had passed the MHP 1.0.2 conformance tests. The problems reported were then analysed to understand whether they could reasonably be addressed by additional conformance tests. Problems not suitable to be addressed by additional conformance tests include the following:

- problems due to lack of clarity in the specification are not suitable since conformance tests must relate to assertions and assertions to language in the specification
- problems of poor quality of implementation or reliability, e.g. the first call to a particular API working but subsequent calls failing

Examples of the kind of problems which could be addressed by additional conformance tests include the following:

- features for which assertions exist but whose corresponding test application has not been created
- features for which no assertion exists, for example changes to the MHP specification after the initial set of assertions was developed. In this case, changes between MHP 1.0.1 and 1.0.2, between 1.0.2 and 1.0.3 and changes found in the errata to MHP 1.0.3.
- features for which the assertion or the test strategy are insufficient. One example of this would be API calls which can read information from a number of different locations where the assertion and/or test strategy only test one of the possible locations

Specific examples of the problems that have been addressed by additional conformance tests developed in the project include the following:

- Text rendering and font metrics. These problems were partly a matter of insufficient coverage of assertions and test strategies used for developing the first versions of the Test Suite and partly due to changes in the MHP specification between 1.0.2 and 1.0.3.
- Access to DVB-SI. These problems were due to the tests for the DVB-SI API only testing the most obvious DVB-SI table for each method. For example, tests related to event information only tested retrieving information from the EIT present / following actual table and not from the 3 other places in which event information can be carried.
- Locators. A number of APIs in MHP can accept several different forms of locator as input. Often these APIs were tested with only one of the possible forms.

ACHIEVEMENTS IN INTER-OPERABILITY

Figure 3 gives an overview on the achievements made by the project in terms of improving the MHP Test Suite (until the time when this paper was prepared) and also shows the fields which were prioritised by the previous research on interoperability.

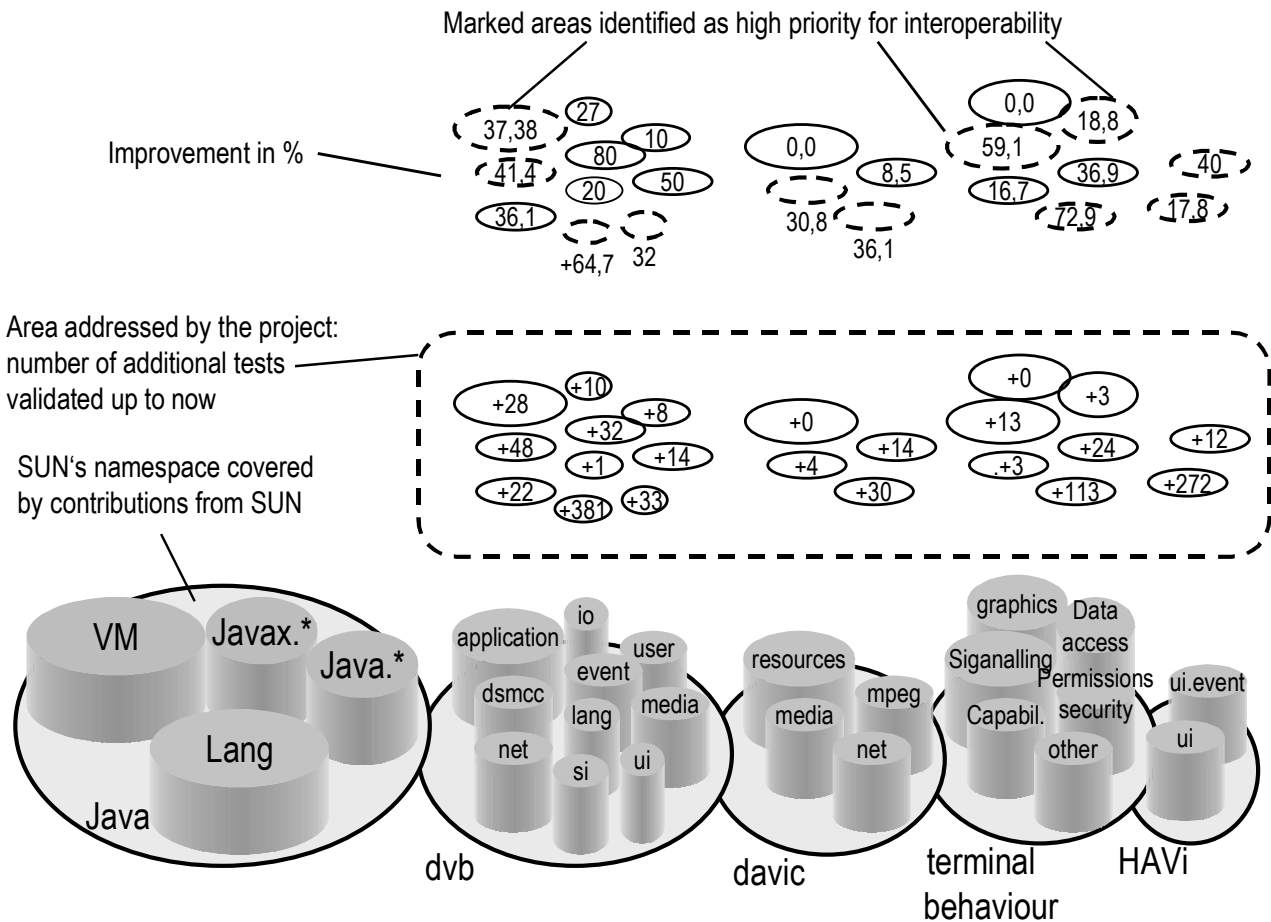
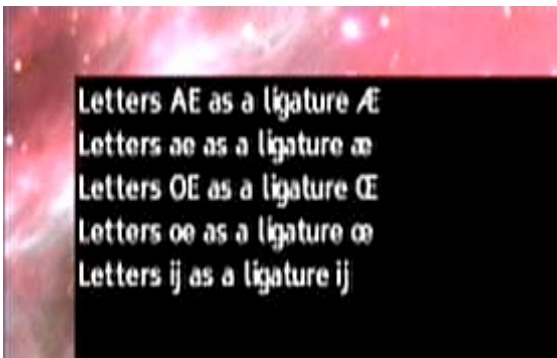


Figure 3 – Achievements in improvement of inter-operability (numbers of tests)

It shows a significant improvement in the number of non-trivial tests for all areas which are within the scope of the project and which have been identified as relevant. The picture in figure 4 gives an example for a newly developed test which allows to test special characters and the overall rendering of fonts.



An up-to-date overview on the numbers and sample demonstrations of tests will be given in the IBC exhibition on the booth of the NAVSHP IST Village (10.412).

Figure 4 – Sample screenshot of a test on font rendering

LOOKING FORWARDS

In 2004 and so far in 2005 the focus of the MHP-CONFIDENCE project has been the MHP 1.0.3 test suite. Moving forwards, the MHP Confidence project will be looking at a test suite for the mandatory parts of the MHP 1.1 specification, recently updated by DVB as MHP 1.1.2 (6). It will also be considering a test suite for receivers supporting the PVR-PDR features defined by the recently issued "Digital Recording Specification for Globally Executable MHP" (7) and "PVR/PDR Extension to the Multimedia Home Platform" (8).

The MHP 1.1 series of specifications extend the MHP 1.0 series with support for features such as storage of applications locally in the receiver, download of applications via the internet and access to smart cards - for applications such as t-government and health. There is also an optional internet access profile and an optional HTML profile. The most recent specification in the series, MHP 1.1.2, further adds a definition of how MHP should work in a HD video environment, support for MHP in 525-line/60Hz countries, support for implementing a UK DTT MHEG-5 decoder as a MHP application and a number of other features.

The MHP PVR-PDR specification defines an extension to MHP to support recording and playback of digital video and audio. This includes both scheduled and time-shift recording and the respective play-back. There is limited support for the recording and playback of interactive applications including the ability for recorded applications to offer extra features when played back, for example random access within the recorded piece of content. The specification also includes an interface to the TV-Anytime content referencing and metadata systems.

CONCLUSION

The first MHP 1.0 test suite resulted in a major improvement in inter-operability between MHP applications and the various different receiver implementations. The work of the MHP-CONFIDENCE project should result in a further significant improvement in inter-operability.

Measuring the scale of this improvement can happen when application developers have the time and opportunity to test their applications on several different receivers passing the updated test suite. This is likely to be some time in the first half of 2006.

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