Air Interface Protocol: Interoperability Test Report, 26 March 2013

RTIG Library Reference: ***RTIGPR008-D005-0.2***

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List of contents

1 Introduction

1.1 This document

1.1.1 This document, produced by RTIG, documents the activities and outcomes of the RTIG Digital Air Interface Protocol (DAIP) Interoperability Testing day held on 26 March 2013.

1.1.2 This document should be read in conjunction with:

- RTIGT030-1.1, "Digital air interface protocol", which documents the protocol.
- RTIGPR008-D004-1.0, "Digital Air Interface Protocol: Interoperability Test Plan", which documents the tests applied to the systems and on-bus units.

1.2 Status of this document

1.2.1 This document provides evidence for all stakeholders on how far systems used during these tests are interoperable with each other. It also provides an opportunity for the suppliers and RTIG to identify and resolve any integration issues.

1.2.2 It remains the responsibility of suppliers to ensure their system meets the relevant protocol specifications, and RTIG accepts no liability for the performance of any product.

1.3 Test plan

1.3.1 The purpose of these tests is to establish correct construction, transmission and reception of messages using the RTIG DAIP, RTIGT030-1.1, between equipment and systems developed by various suppliers. It is not intended to test the general OBU / back office environment in which the DAIP functionality has been implemented (such as ticketing functionality, reporting functionality, MMI logic, etc.).

1.3.2 The test setup and procedures were based on the document "Digital Air Interface Protocol: Interoperability Test Plan", which provides a set of mandatory and optional test scenarios. To maintain consistency across all OBU suppliers, Trapeze ITS created a simplified data supply with actual NaPTAN and Bus IDs for use during the tests.

1.3.3 The event was hosted by Trapeze ITS at their laboratories in Loughton (London), and was attended by four suppliers: Cloud Amber, Hogia Group, Parkeon and Trapeze ITS. Mobius Networks provided the event with communications engineer, SIMs and network assistance.

1.3.4 Three back office systems and two on bus units were tested at the event, and they were:

- Cloud Amber: 'Icarus' which is a *Back Office* system;
- Hogia Group: 'PubTrans' which is a *Back Office* system;
- Trapeze ITS: 'Novus' which is a *Back Office* system;
- Parkeon: 'Wayfarer 200' which is an *On Bus Unit*;
- Trapeze ITS: 'Intelligent Transport Module' (ITM) which is an *On Bus Unit*.

1.4 Glossary

DAIP	Digital Air Interface Protocol
ITM	Intelligent Transport Module
MM	Man Machine Interface
OBU	On Bus Unit
RTIG	Real Time Information Group

2 Test Results

2.1 Introduction

2.1.1 To ensure basic fulfilment of real time responsibilities, the interoperability tests included messages that are described as mandatory by the RTIGT030-1.1 document (Test set 1), as well as basic communication management and communication exceptions / disturbances (Test set 2). Messages considered optional were also included in the test plan, and included if requested by a supplier (Test set 3). The test sets were as follows:

- Test set 1: *Mandatory Core Functions* established the interoperability between OBU and back office system using 5 different types of messages.
- Test set 2: *Mandatory Communication Management Features* investigated the basic communication link between the systems.
- Test set 3: *Optional Event Functions* was carried out to review event message transfer between devices.

2.1.2 Further details about each test set can be found in the RTIGPR008-D004-1.0 document (Digital Air Interface Protocol: Interoperability Test Plan).

2.1.3 Although there were three Back Office systems and two OBUs present, only five tests were carried out: the omitted pairing was the Trapeze ITS OBU against the Trapeze ITS Back Office, which was considered in practice to be significantly less risky for implementers.

2.2 Test Set 1: Mandatory Core Functions

2.2.1 This test set required the correct transmission and reception / decoding of messages between the OBU and back office system. The messages being tested were:

- Session Log On – Message IDs #10 and #20;
- Route Log On (Journey Initiation) – Message IDs #30 OR #31;
- Position Update – Message IDs #40 OR #41;
- End of Journey Message – Message ID #39;
- Session Log Off – Message ID #11.

Parkeon OBU – Cloud Amber Back Office

2.2.2 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Cloud Amber Icarus.

2.2.3 The OBU functions successfully triggered and transmitted each of the five messages to the Back Office system. The Back Office system successfully received all messages and correctly decoded them.

Parkeon OBU – Hogia Back Office

2.2.4 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Hogia Group PubTrans.

2.2.5 The OBU functions successfully triggered and transmitted each of the five messages to the Back Office system. The Back Office system successfully received all messages and correctly decoded them.

Parkeon OBU – Trapeze Back Office

2.2.6 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Trapeze ITS Novus.

2.2.7 The OBU functions successfully triggered and transmitted each of the five messages to the Back Office system. The Back Office system successfully received all messages and correctly decoded them (subject to the important proviso of Section 3.3).

Trapeze OBU – Cloud Amber Back Office

2.2.8 This test involved the following devices:

- OBU: Trapeze ITS ITM;
- Back Office system: Cloud Amber Icarus.

2.2.9 The first four OBU functions were tested, and each successfully triggered and transmitted the relevant messages to the Back Office system. The OBU function 'Session Log Off' was not tested. The Back Office system successfully received all messages and correctly decoded them.

Trapeze IT OBU – Hogia Back Office

2.2.10 This test involved the following devices:

- OBU: Trapeze ITS ITM;
- Back Office system: Hogia Group PubTrans.

2.2.11 The first four OBU functions were tested, and each successfully triggered and transmitted the relevant messages to the Back Office system. The OBU function 'Session Log Off' was not tested. The Back Office system successfully received all messages and correctly decoded them.

2.3 Test Set 2: Mandatory Communication Management Features

2.3.1 This test set was designed to review the link establishment and reliability between the OBU and back office system. The features tested were:

- Session Establishment;
- Reconnection after disturbance of Communication.

2.3.2 'Session Establishment' was considered successful if message data transmitted between the OBU and Back Office system. Since all devices being tested displayed evidence of message data transfer during Test set 1, they have all been successful at 'Session Establishment'. Thus, only the results for 'Reconnection after disturbance of Communication' are discussed in this section.

Parkeon OBU – Cloud Amber Back Office

2.3.3 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Cloud Amber Icarus.

2.3.4 To create disturbance, the OBU was restarted. Successful re-establishment of OBU session with Back Office was confirmed through continued message data transfer between the devices.

2.3.5 Icarus records whether an OBU session has logged off. In the absence of a session log off request, all consecutive login requests from the same OBU are automatically attached to the previous session for that OBU, with an indication of connection failure.

Parkeon OBU – Hogia Back Office

2.3.6 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Hogia Group PubTrans.

2.3.7 To create disturbance, the Back Office communication network was removed. Successful re-establishment of OBU session with Back Office was confirmed through continued message data transfer between the devices.

2.3.8 Wayfarer 200 stored all session details during the network outage, and on session re-establishment, the details were transmitted to the Back Office system.

Parkeon OBU – Trapeze Back Office

2.3.9 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Trapeze ITS Novus.

2.3.10 Connection disturbance was not tested between these two devices.

Trapeze OBU – Cloud Amber Back Office

2.3.11 This test involved the following devices:

- OBU: Trapeze ITS ITM;
- Back Office system: Cloud Amber Icarus.

2.3.12 To create disturbance, the OBU's communication network was removed. Successful re-establishment of OBU session with Back Office was confirmed through continued message data transfer between the devices.

Trapeze OBU – Hogia Back Office

2.3.13 This test involved the following devices:

- OBU: Trapeze ITS ITM;
- Back Office system: Hogia Group PubTrans.

2.3.14 To create disturbance, the Back Office communication network was removed. Successful re-establishment of OBU session with Back Office was confirmed through continued message data transfer between the devices

2.4 Test Set 3: Optional Event Functions

2.4.1 This test set was designed to review the link establishment and reliability between the OBU and back office system. The features tested were:

- Event Function: OBU to Back Office;
- Event Function: Back Office to OBU.

Parkeon OBU – Cloud Amber Back Office

2.4.2 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Cloud Amber Icarus.

2.4.3 Three event messages were generated by the OBU: two automatic events and a manual event with text. The Back Office system successfully received each message and correctly decoded them.

2.4.4 The messages from Back Office initially failed to be recognised by the OBU. However, on reconfiguring the Back Office system, the message was successfully received and correctly decoded by the OBU.

Parkeon OBU – Hogia Back Office

2.4.5 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Hogia Group PubTrans.

2.4.6 Two event messages were generated by the OBU: an automatic event and a manual event with text. The Back Office system successfully received each message and correctly decoded them.

2.4.7 The messages from Back Office initially failed to be recognised by the OBU. However, on reconfiguring the OBU, the message was successfully received and correctly decoded.

Parkeon OBU – Trapeze Back Office

2.4.8 This test involved the following devices:

- OBU: Parkeon Wayfarer 200;
- Back Office system: Trapeze ITS Novus.

2.4.9 A manual event message with text was generated by the OBU. The Back Office system successfully received it and correctly decoded it.

2.4.10 No messages were sent from the Back Office system to the OBU.

3 Issues

3.1 Version

3.1.1 The protocol wrapper encodes the version number of the protocol as four BCD nibbles, representing version "NN.NN". This led to differing implementations by suppliers, who were unclear as to whether the current version "1.1" should be encoded as BCD 0101 or BCD 0110.

3.1.2 The issue had emerged during bilateral discussions preparatory to the testing day but was not formally raised until the testing day. Suppliers generally adopted an approach in which the back office accepted either 0110 or 0101 as representing v1.1; however this is clearly not a sustainable solution.

3.1.1 RTIG accepts that the protocol needs to be clarified on this point, and will resolve this by correspondence as a matter of urgency. Our current position is that the second post-decimal digit is intended to allow for minor revisions and that "1.1" should correctly be encoded as if it were "01.10", is as 0110.

3.2 Position Update

3.2.1 There is an inconsistency between the protocol definitions of message IDs #40 and #41, the way that schedule deviation is encoded. There are two aspects to this:

a) In #40, the parameter is type S (signed integer), while in #41 it is type X (binary).

b) In #40 the parameter value that encodes "unknown" is Hex 80, while in #41 it is Hex FF.

3.2.2 RTIG accepts that the protocol needs to be clarified on this point, and will resolve this by correspondence. Our current position is:

- For issue a) we consider that X is in error and the type should be S in both cases. There is no logic to encoding what is essentially a signed integer quantity to a binary parameter. Apart from anything else, this leaves open the question of how the "negative" values (Hex 80 to Hex FE) should be interpreted (does 80 mean -1 or does FE mean -1?)

- If the type is S, then the only logical code for "unknown" is Hex 80.

3.3 Compliance

3.3.1 One of the devices being tested, the Trapeze ITS 'Novus', was missing the mandatory field 'Public Service Code'. Software changes were made during the event to prove the software can easily be updated to include this field, and to exchange it correctly. We believe that this change can easily be made at production level, and Trapeze has undertaken to ensure this.

4 Conclusion

4.1 Five systems that were tested during this event:

- Cloud Amber: 'Icarus' which is a *Back Office* system;
- Hogia Group: 'PubTrans' which is a *Back Office* system;
- Parkeon: 'Wayfarer 200' which is an *On Bus Unit*;
- Trapeze ITS: 'Novus' which is a *Back Office* system;
- Trapeze ITS: 'Intelligent Transport Module' (ITM) which is an *On Bus Unit.*

4.1.2 There were some communication set-up issues, but following the resolution of these the tests went generally smoothly. In summary:

- All devices successfully passed the majority of the tests. In a very few cases there are issues to be fixed; we believe these are simple.
- There are a couple of places where the RTIG protocol has been found to require clarification or correction. Again these are not major problems; a minor upissue will be published within a few weeks.

4.1.3 This test day was limited in that:

- There are other (optional) RTIG messages that were not tested.
- There are other suppliers who aim to have compliant products, but who were not yet ready to test.

In retrospect it probably made the day more practical to keep testing to a practical level. The second test day anticipated towards the end of the year can now benefit from the clarifications of the protocol.