DVB-RCS Interoperability
Phase 2 Executive Summary

European Space Agency Contract Report

The work described in this report was done under ESA contract 16900/02/NL/AD.
Responsibility for the contents resides in the author or organization that prepared it.

Date: 4 February 2004

Title Page

ESA Contract 16900/02/NL/AD
DVB RCS Interoperability

Rev Date	Rev.	Document ID
2004-02-04	B	Interop Phase 2 Executive Summary Rev B

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Introduction

The success of systems such as GSM and DVB-S can largely be attributed to the widespread commercial support for the standards defining them. The existence of multiple sources for key technologies contributes to increased confidence of both consumers and service providers. The availability of open standards fosters a healthy competition in all parts of the value chain and leads to volume production of key system elements. As a result, system costs are driven downwards, leading in turn to lower cost for the consumer and hence increased market acceptance of the technology.

The DVB-RCS Return Channel System underwent final standardization by ETSI in late 2000. It is the first truly open standard for interactive satellite systems, and therefore provides a unique opportunity for the satellite community to benefit from the advantages mentioned above.

Despite the promises of the open standards approach, the DVB-RCS standard is not as tightly defined as for example the GSM standard. A number of options are permitted, and the current result is that independently developed DVB-RCS implementations contain differences that render them not immediately interoperable with other implementations. The three major equipment manufacturers, EMS, Nera and Newtec have recognized that this issue needs to be addressed in the short term. All three manufacturers are committed to interoperability of their terminals and hubs in order to realize the full potential of the open standards approach. While the emphasis is on adapting the terminals as required, it is recognized that some minor modifications to the hubs may also have to be implemented.

In order to assist the manufacturers in achieving this goal, ESA has awarded a contract to EMS, Nera and Newtec to make necessary modifications to their existing equipment and to demonstrate interoperability between their hubs and terminals.

This report presents the results of the work performed on Phase 2 of the overall activity. The objectives of Phase 2 were to carry out the test plans that were prepared by the manufacturers during Phase 1 of the project together with the necessary terminal and hub modifications required for interoperability. In addition to the actual testing, the Phase 2 work also included the preparation of test procedures and test reports. These objectives have been fully achieved.

This executive summary constitutes the deliverable for the final milestone payment by ESA/ESTEC on this project.

1. PROJECT SCOPE

The goals of this Phase 2 project were:

1. To carry out the series of interoperability tests defined in Phase 1, with each manufacturer's terminal tested against the other manufacturers' hubs. The level of Interoperability testing is defined to be within the scope of compliance to the DVB-RCS Air Interface Standard (EN301790) and involves demonstration of basic IP connectivity including UDP Ping, FTP (file transfer) and HTTP (web browsing).
2. To produce a set of detailed test plans for the testing of other manufacturers' terminals against one's own hub.
3. To assist Cetecom in defining the generic DVB-RCS interoperability test plans.

2. OVERALL APPROACH AND ACHIEVEMENTS

EMS, Nera and Newtec have now completed a development and testing program to demonstrate interoperability between each others' DVB-RCS terminals and hubs. This overall activity consisted of 4 consecutive steps, described below. The first two steps comprised the Phase 1 project, which started on 28 October 2002 and was completed by the commencement of work on Phase 2, in late April 2003.

The current Phase 2 work, in which actual testing of terminals against other manufacturers' hubs took place, was completed in [August 2003.]

For the purposes of this report, the companies Newtec and SpaceBridge (terminal provider for Newtec) are considered as a single entity, represented by Newtec, unless otherwise noted.

2.1 Step 1: Phase 1, WP110 - Analysis and Test Plan (completed prior to this project)

The first step in the interoperability validation process was for each of the manufacturers to analyze the differences between their own system and the other manufacturers'. This was performed as planned during the first 4 weeks of the project. Equipment technical details were exchanged and face-to-face meetings were successfully held among the various manufacturers' technical representatives.

At the end of WP110, each manufacturer had gained a thorough understanding of the scope of the modifications required to their equipment. A consolidated list of actions from meetings held as part of the work performed in WP110 was produced. These actions were either resolved by analysis or where necessary included in WP120 for equipment modifications. All action items relating to WP110 work scope were successfully closed by the three manufacturers, either by analysis or by equipment modification and testing.

During this stage, a preliminary test plan was drawn up that presented all common aspects in the form of test cases between the 3 manufacturers' hubs. Cetecom participated at the meetings and received all documentation exchanged between parties for comments.

2.2 Step 2: Phase 1, WP120 – Terminal/Hub Modifications & WP130 - Test Plan (completed prior to this project)

The second step to achieve interoperability was to actually implement the identified modifications to each of the terminals and the hubs (WP120). At the end of the second step, each terminal and hub contained the required modifications to enable them to interoperate with the other manufacturers' hubs and terminals respectively as agreed during WP110. This step was fully completed, and each of the 3

manufacturers deemed their Hubs and Terminals ready for the Interoperability testing, to be carried out during Phase 2.

An additional important output of this second step was preparation of the set of detailed test plans (WP130) for testing of each manufacturer's terminal against the various hubs (EMS, Nera, Newtec). These were prepared by the hub manufacturers for their own hub, building upon the common test plan that was produced as part of WP110. Note that the test plans produced comprise specific tests for the specific equipment under test. Each Hub manufacturer produced their own Hub test plan as part of WP130. These test plans built upon the Common Test Plan of WP110, but also included Hub-specific aspects such as optional test cases and added more information to each test case such as configuration/test equipment and test method to be employed.

In this area the involvement of Cetecom was of great benefit. EMS, Nera and Newtec cooperated with Cetecom throughout this project and produced the Common Test Plan for public availability at the end of Phase 1. It was planned to make a more definitive version of this document available at the end of Phase 2, once any issues encountered during the actual testing were resolved and incorporated.

2.3 Step 3: Phase 2, Interoperability Testing

The third step, which comprised the main part of Phase 2, involved producing detailed test procedures and performing the actual testing of each manufacturer's terminal against the other manufacturers' hubs, at each hub manufacturer's premises.

The first part of the testing program involved acquisition of the different hubs' forward link signal played back by means of specialized test equipment loaned to the interoperability partners by Verisat of Norway.

The second part involved travelling to the various partners' premises with an IDU, carrying out as many of the foreseen tests as possible, and debugging whenever possible.

This was followed by a short period allowing further identified modifications to be implemented on the test terminals and hubs.

Finally, a second round of testing was carried out, with final minor equipment modifications and successful completion.

All test cases have been passed successfully for all combinations of equipment, namely:

- EMS Hub – Nera Terminal
- EMS Hub – Newtec (Spacebridge) Terminal
- Nera Hub – EMS Terminal
- Nera Hub – Newtec (Spacebridge) Terminal
- Newtec Hub – EMS Terminal
- Newtec Hub – Nera Terminal

The final results of this step are:

- EMS, Nera and Newtec terminals validated for interoperability against each manufacturer's hubs.
- Test procedures and Test Reports describing in detail the tests performed and the results achieved.

2.4 Step 4: Phase 2, Handover to Cetecom

As a result of experience gained during the tests performed in Step 3, the test plan identified in Step 2, on which the more detailed test procedures produced in Step 3 have been based, did not require any modification. The 3 manufacturers thereby confirmed the applicability of the generic test plan for use by Cetecom for general DVB-RCS compatibility certification. The generic test plan is intended to be published and made publicly available, allowing third party DVB-RCS terminal manufacturers to validate their terminals against particular hubs by means of an independent test house such as Cetecom.

Some support from the manufacturers is expected to be required to fully hand over the testing responsibilities to Cetecom and to assist in establishing the test facilities at Cetecom.

3. SUMMARY OF WORK CARRIED OUT UNDER THIS CONTRACT

i) Test preparations, including testing own terminal at own premises using test vectors from other manufacturers
ii) Testing round 1 of own terminal at both of the other manufacturers' premises
iii) Testing round 1 of other manufacturers' terminals against own hub
iv) Analysis of round 1 test results
v) Testing round 2 of own terminal at both of the other manufacturers' premises
vi) Testing round 2 of other manufacturers' terminals against own hub

The Phase 2 work flow is shown in Figure 1 below. The durations of WP220/230 and WP240 were extended and overlapped in time, for schedule and logistics efficiency reasons.

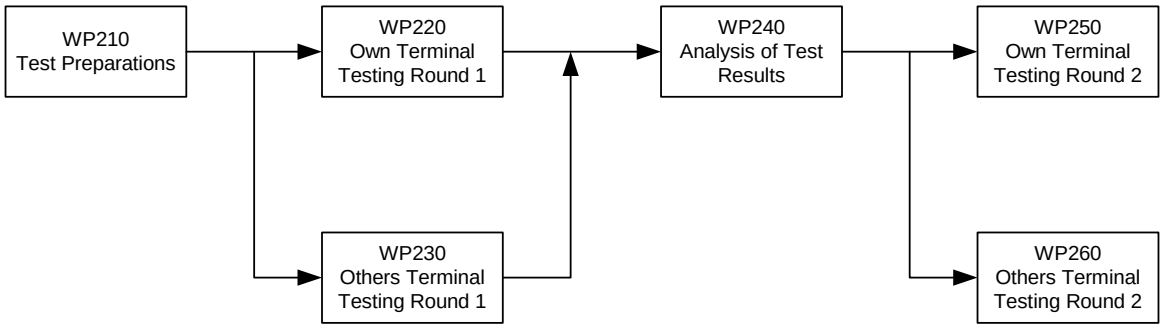

Figure 1: Work Flow Diagram

3.1 WP 210: Test Preparations & Test Cases

Work required prior to the start of Round 1 testing was performed in this work package, as follows:

- Test procedures containing more details than the Phase 1 test plan were prepared by each Hub manufacturer.
- Using the Verisat FLA (Forward Link Analyzer) tool, Forward Link test vectors were captured at the FLSS output of each Hub and provided to the other Terminal manufacturers.
- Using the Verisat FLA tool and/or other off-the-shelf test equipment, the Terminal manufacturers played back the test vectors to perform an initial interoperability check with their equipment. This

provided an early confirmation and increased confidence that the actual interoperability tests at the Hub manufacturers' premises would be successful.

- Phase 1 Documentation was updated and finalized, as required (namely: List of Hub & Terminal Modifications, Hub Test Plans)
- A test schedule was agreed between all manufacturers and Cetecom. Tests were performed between May 19, 2003 (start of Round 1) and August 22, 2003 (end of Round 2).

The test cases performed are listed as follows. Please refer to the appendix of this report for a detailed description of each test case.

1 FORWARD LINK ACQUISITION
- 1.1 Acquire Forward Link
- 1.2 Acquire NCR Lock

2 RECEIVE SYNC STATE
- 2.1 CSC Burst Transmission
- 2.2 TIM reception

3 READY FOR COARSE SYNC (APPLICABLE TO EMS HUB ONLY)

4 READY FOR FINE SYNC (NOT APPLICABLE TO NEWTEC HUB)
- 4.1 SYNC Burst
- 4.2 CMT

5 FINE SYNC STATE
- 5.1 Sync Maintenance (not applicable to Newtec Hub)
- 5.2 Forward Link Transmission
- 5.3 Return Link Traffic Transmission & Capacity Requesting

6 LOG-OFF
- 6.1 Hub-initiated Log-off
- 6.2 RCST-initiated Log-off

7 HOLD STATE (NOTE: CHECK APPLICABILITY TO NEWTEC HUB)
- 7.1 Transition to HOLD State
- 7.2 Transition from HOLD State

8 LOG-ON
- 8.1 Wake-Up of RCST
- 8.2 Log-on Denied
- 8.3 Log-on Busy

9 APPLICATION TESTING
- 9.1 UDP Ping
- 9.2 FTP
- 9.3 Web-Browsing/HTTP (client at RCST)

3.2 WP 220: Terminal Testing Round 1

Work performed during Round 1 testing included:

- A representative from each Terminal manufacturer traveled with its RCST IDU hardware (In Door Unit) to the premises of the other two Hub manufacturers for up to 1 full week of on-site interoperability testing.
- Representatives from Cetecom were invited and observed most of the tests that were conducted.
- The actual duration of each on-site visit depended on successes and problems encountered during the week, and how much progress could be achieved on-site in real time.
- The purpose of this 1st round of testing was to successfully complete as many test cases as possible against each Hub, identifying problems and solutions, and implementing fixes whenever possible. It was observed that, in cases where problems had to be identified and fixed, immediate assistance from the RCST IDU software developers proved invaluable. This was achieved with a software presence either on-site, or on-call at the RCST manufacturer's premises.

Although a second round of testing was foreseen from the beginning, the goal of Round 1 testing was to perform all test cases successfully. In all cases, Round 1 testing was quite successful, to the extent that a press release was issued after this round. However, in order to close all open points and perform all test cases with more stable and definitive Hub and RCST software loads, Round 2 testing was nevertheless required.

To avoid repetition of the results, all discussions pertaining to Round 1 and Round 2 test results are included in the corresponding Hub sections presented below.

3.3 WP 230: Hub Testing Round 1

The purpose of this 1st round of testing was to complete successfully as many test cases as possible against each Hub, identifying problems and solutions, and implementing fixes whenever possible. Software development support on the Hub side was also seen to be required, as some of the problems encountered during Round 1 were related to the Hub implementation.

The following is a summary of the events that unfolded during Round 1 testing. All problems encountered were either fixed during Round 1 or on time for Round 2.

Nera at EMS:
- a workaround involving the specific PID values used required;
- slightly different interpretations of some timing information, introducing a certain amount of jitter in the timing of the return link traffic bursts, had to be cleared up;
- some problems were experienced with RBDC, due to different interpretations of the capacity request field;
- some RCST TIM status bits were not implemented correctly and/or interpreted differently;

Newtec at EMS:
- stability problems were encountered which were eventually fixed;

EMS at Nera:
- some timing issues were encountered and then fixed with CSC bursts;

Newtec at Nera:
- problems were encounetered and then fixed with spectrum inversion, preamble scrambling and traffic payload decoding;

EMS at Newtec:
- timing issues were encountered and then fixed involving the TBTP;
- UDP and FTP performance problems were encountered and eventually tied to a set-up issue and cleared up;

Nera at Newtec:
- an AAL-5 CRC computation error was found and corrected;
- different interpretations of the SCT table were encountered and cleared up.

3.4 WP 240: Analysis of Round 1 Test Results

Based on the results achieved during Round 1 testing, the following tasks were performed in order to ensure a successful Round 2:
- An account of the events of Round 1 equipment combination was prepared, exchanged and agreed between the Hub and Terminal manufacturers.
- The corresponding Test Report was finalized for this round of tests by the Hub manufacturers.
- A list of corresponding Hub and Terminal modifications to be implemented before the start of Round 2 was prepared, exchanged and agreed between the manufacturers. This list is presented in the Final Report.
- The agreed modifications were implemented on the Hub and Terminal.

3.5 WP 250: Terminal Testing Round 2

Work performed during Round 2 testing included:
- A representative from each Terminal manufacturer traveled with its RCST IDU hardware (In Door Unit) to the premises of the other two Hub manufacturers for on-site interoperability testing.
- Representatives from Cetecom were invited and observed the tests that were conducted.
- The actual duration of each on-site visit depended on successes and problems encountered during the week, and how much progress could be achieved on-site in real time.

The purpose of this 2nd round of testing was to complete successfully all test cases of each Terminal against each Hub, identifying problems and solutions, and implementing fixes, if any required, in real time.

To avoid any repetition of the results, the discussions pertaining to Round 2 test results are included in the corresponding Hub section presented below.

No day-by-day account of Round 2 is necessary as all test cases were passed successfully for all combinations of Terminal and Hub equipment.

3.6 WP 260: Hub Testing Round 2

For each combination of Hub and RCST IDU equipment, the finalized version of each test report was prepared by each Hub manufacturer. Cetecom also prepared their own set of test reports as the final outcome of Round 2 testing.

All test cases were passed successfully for all combinations of Terminal and Hub equipment. No Hub modifications were required as an outcome of Round 2.

3.7 Interoperability Issues

Based on the outcome of these tests, the following interoperability potential issues have been noted and should be kept in mind for future interoperability activities, including possible clarifications to be made to the DVB-RCS Standard itself:

- **Handling of missing Contention Control and Correction Control descriptors**: it is recommended that the terminal is configured with default values for the parameters signalled in these descriptors to avoid interoperability problems in cases where these descriptors are not signaled.

- **TIM RCST Status bits**: definition and explanations should be expanded to achieve a clear definition. Behaviour of a Terminal after reception of a log-off message in RCST status field should be specified in the standard.

- **Capacity Requests**: the definition and usage of the capacity requests has been pointed to as an area of potential interoperability problems. The definition should be improved to a detailed enough level to ensure interoperability.

5. CONCLUSION

The objectives of this Interoperability Phase 2 activity were mainly to carry out the interoperability tests defined during Phase 1, by means of laboratory tests involving EMS, Nera and Newtec/Spacebridge terminals against hubs at the other manufacturers' premises.

Following two rounds of testing, with a number of modifications implemented to the terminals and hubs between the two rounds, all of the tests were successfully completed. These tests demonstrated stable acquisition and operation of the terminals as well as the ability to use UDP Ping, FTP and HTTP (web browsing). This is a very important and necessary first step towards an eventual goal of achieving "plug and play" interoperability.

The completion of this work marks the end of the joint interoperability activity involving EMS, Nera, Newtec and Spacebridge. It marks a unique cooperation between competing satellite equipment manufacturers to further the commercial competitiveness of products based on the DVB-RCS standard by advancing the level of interoperability that can be assured. The involvement of Cetecom throughout the process ensures that the results are carried forward in the more public arena. The test procedures to be published will provide the basis for interoperability certification testing by independent test houses in the future. The results have also provided important contributions to the work of the Satlabs group, which is working to define a set of interoperability profiles for DVB-RCS. These published profiles will allow new manufacturers to manufacture terminal equipment that is guaranteed to attain a certain level of interoperability with other conforming manufacturers' hubs.

Appendix 1

Interoperability Test Plan

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide an overview of the tests that shall be carried out in order to ensure basic level of interoperability between the three DVB-RCS Hub and RCST manufacturers EMS, Nera and Newtec. As such, it shall be used as a basis for producing more detailed test procedures for interoperability testing against each hub.

1.2 Scope

This document focuses on testing normal behavior in the interaction between Hub and RCST, since that is what can reasonably be accomplished within the scope of Phase 2 of interoperability testing. It is understood that full DVB-RCS compliance testing will also have to thoroughly test abnormal behavior and anomalies to ensure a properly functioning system in all situations, but the scope of such a task is too great to be carried out at this stage.

2. TEST SPECIFICATION

2.1 Forward Link Acquisition

2.1.1 Acquire Forward Link

Objective:
Check that RCST is capable of receiving and reading all DVB-RCS specific tables (no need to check the interpretation of these tables at this point)

Method:
Dump tables in a raw format (**preferred**), OR force Hub to drop one of the tables and see how the RCST reacts

2.1.2 Acquire NCR Lock

Objective:
Check that Terminal is using NCR for timing and frequency reference purposes

Method:
Use RCST diagnostic tools/output to verify that RCST has acquired lock on the NCR signal embedded in the forward link

2.2 Receive Sync State

2.2.1 CSC Burst Transmission

Objective:
Verify correct reception and formatting of CSC burst in Hub. This test requires that some means of performing coarse synchronization exist so that the CSC burst is transmitted in the correct time-slot.

Method:
Dump the CSC burst at hub side and verify that its formatting is in accordance with the TCT table transmitted over the forward link.

2.2.2 TIM reception

Objective:
Verify correct reception of uni-cast TIM at RCST in response to CSC burst transmission.

Method:

Dump uni-cast TIM message at RCST side and verify that addressing is correct and that the RCST transitions to either the 'Ready for Coarse Sync' state or the 'Ready for Fine Sync' state.

2.3 Ready for Coarse Sync (applicable to EMS Hub only)

Objective:

Method:

2.4 Ready for Fine Sync (not applicable to Newtec Hub)

2.4.1 SYNC Burst

Objective:
Verify correct SYNC burst reception and formatting at Hub side.

Method:
Dump SYNC burst at the hub side, and verify that formatting is in accordance with information transmitted in the TCT table over the forward link.

2.4.2 CMT

Objective:
Verify correct reception of CMT at RCST side in response to SYNC transmission.

Method:
Dump CMT table received from the hub in response to a SYNC burst. Verify correct reception and that RCST enters Fine Sync State on receiving CMT with time/frequency errors below the thresholds stated in the SYNC Assign Descriptor transmitted over the forward link.

2.5 Fine Sync State

2.5.1 Sync Maintenance (not applicable to Newtec Hub)

Objective:
Verify stable Sync Maintenance behavior.

Method:
Verify that RCST stays in Fine Sync State through the Sync maintenance procedure for one hour without being logged off by the hub.

2.5.2 Forward Link Transmission

Objective:
Verify quasi error-free UDP packet transmission over forward link.

Method:
Send $1*10^6$ UDP packets - 1500 bytes packet size - over the Forward Link at 512kbps. SNR on forward link $\geq$ 12dB. Verify that all packets are received error-free.

2.5.3 Return Link Traffic Transmission & Capacity Requesting

2.5.3.1 CRA Capacity Class

Objective:
Verify quasi-error free UDP packet transmission over the return link using the CRA capacity class.

Method:

Send 1*10^6 UDP packets - 1500 bytes packet size – over the return link with CRA capacity of 100 kbps and FCA disabled. Packet rate shall be 50 kbps (i.e. significantly less than available CRA). SNR on return link shall be link ≥ 12dB. Verify that all packets are received error-free.

2.5.3.2 VBDC Capacity Class

Objective:
Verify quasi error-free UDP packet transmission using the VBDC traffic class.

Method:
Send 1*10^6 UDP packets - 1500 bytes packet size – over the return link using VBDC traffic capacity requests. CRA capacity shall be set to 0 (or minimum). Packet rate shall be 100 kbps. SNR on return link shall be link ≥ 12dB. Verify that all packets are received error-free and that the capacity requests have the correct formatting.

2.5.3.3 RBDC Capacity Class

Objective:
Verify quasi error-free UDP packet transmission using the RBDC traffic class.

Method:
Send 1*10^6 UDP packets - 1500 bytes packet size – over the return link using RBDC traffic capacity requests. CRA capacity shall be set to 0 (or minimum). Packet rate shall be 100 kbps. SNR on return link shall be link ≥ 12dB. Verify that all packets are received error-free and that the capacity requests have the correct formatting.

2.5.3.4 CRA+FCA Capacity class

Objective:
Verify quasi error-free UDP packet transmission using combination of CRA and FCA traffic classes.

Method:
Send 1*10^6 UDP packets - 1500 bytes packet size – over the return link using CRA and FCA capacity. CRA capacity shall be set to 50 kbps. Packet rate shall be 100 kbps (i.e. higher than the CRA to ensure FCA is assigned). SNR on return link shall be link ≥ 12dB. Verify that all packets are received error-free.

Note: Newtec Hub does not use the Sync burst for capacity requesting; instead, a small amount of CRA is provided to the RCST 'in the background'

2.6 Log-Off

2.6.1 Hub-initiated Log-off

Objective:
Verify proper Hub-initiated log-off sequence

Method:
Capture log-off TIM at RCST side and verify with a spectrum analyzer that RCST ceases all transmissions.

2.6.2 RCST-initiated Log-off

Objective:
Verify proper RCST-initiated log-off sequence

Method:
Capture SAC header containing log-off request at hub side and verify with spectrum analyzer that RCST ceases all transmissions.

Note: must check applicability to EMS Hub and RCST

2.7 Hold State (note: check applicability to Newtec Hub)

2.7.1 Transition to HOLD State

Objective:
Verify that RCST transitions to Hold State upon receiving TIM with 'transmit_disable' flag set to '1'. Note that traffic should be flowing over the return link when this test is initiated.

Method:
After sending a TIM with the 'transmit_disable' flag set to '1', cycle the power on the RCST and apply traffic at the input of the RCST. Verify with a spectrum analyzer that the RCST transmits nothing while in the HOLD state.

2.7.2 Transition from HOLD State

Objective:
Verify that, while in HOLD State, the RCST reverts back to 'Receive Sync State' upon receiving TIM with 'transmit_disable' flag set to '0'.

Method:
Apply traffic at the input of the RCST after sending TIM with 'transmit_disable' flag set to '0' and verify that traffic flow is re-established in the return link direction.

2.8 Log-On

2.8.1 Wake-Up of RCST

Objective:
Verify that, while in Receive Sync State, RCST initiates log-on procedure upon receiving TIM with 'wake_up' flag set to '1'. Note that **no** traffic shall be applied at the input of the RCST when initiating the test.

Method:
Check that RCST is capable of logging on to the interactive network and that traffic flow can be established over the forward link by using a UDP packet transmitter at the hub side and a corresponding receiver at the RCST side.

2.8.2 Log-on Denied

Objective:
Verify that RCST, having initiated a log-on procedure and having received a TIM with 'logon_denied' flag set to '1', transmits nothing except possibly a retransmission of the CSC burst

Method:
Use a spectrum analyzer to monitor the output of the RCST and verify that it does not transmit anything except possibly another CSC burst.

2.8.3 Log-on Busy

Objective:
Verify that RCST, having initiated a log-on procedure upon and received a TIM with 'logon_busy' flag set to '1', transmits nothing except possibly a retransmission of the CSC burst

Method:
Use a spectrum analyzer to monitor the output of the RCST and verify that it does not transmit anything except possibly another CSC burst.

2.9 Application Testing

2.9.1 UDP Ping

Objective:
Verify basic UDP/IP connectivity.

Method:
Perform UDP PING in both directions: RCST logged-on with CRA set at 50kbps, default (small) packet size, 1 ping per second, 10 minutes, round trip delay < 1 second. All replies must be received at originating side with a round-trip delay less than 1 second.

2.9.2 FTP

Objective:
To verify file transfers over TCP/IP.

Method:
Perform FTP file transfers in both directions with RCST logged-on with CRA set at 512kbps, file size = 10Mbytes. File transfer duration should be less than 10 minutes, and no retransmissions are allowed.

2.9.3 Web-Browsing/HTTP (client at RCST)

Objective:
To test basic Internet connectivity.

Method:
RCST logged-on with CRA set at 512kbps, true Internet access or Web server at Hub side. Verify stable operation for at least 10 minutes while doing at least the following operations:

- Browse at least 10 different pages
- Do at least one file transfer
- Loading of one specific <to be named> test page