



ATNP/WG3/IP \_\_\_\_

12 April 1996

**AERONAUTICAL TELECOMMUNICATION NETWORK PANEL**

**WORKING GROUP 3 (APPLICATIONS AND UPPER LAYERS)**

**Brussels, Belgium, 15 - 26 April 1996**

**ADS SARPs Simulation Scenarios**

**INFORMATION PAPER**

Prepared by: Peter Cope

Presented by: Danny Van Roosbroek

**SUMMARY**

This paper reports on the use of tools to automate the process of ADS SARPs validation. This is an interim report with some sections to be completed.

## TABLE OF CONTENTS

1. Introduction.....	1
1.1 Scope of Document .....	1
1.2 Background.....	1
1.3 References .....	1
2. Validation Methodology.....	2
2.1 Background.....	2
2.2 Scenario Development.....	2
3. GEODE Modelling - ADS .....	3
3.1 Base ADS SARPs Model .....	3
3.2 Cross-Checking the Model against the ADS SARPs.....	4
4. Identification of Possible Simulation Scenarios .....	5
4.1 Introduction.....	5
4.2 Message Sequence Charts .....	5
4.3 Simulation Scenarios .....	5
4.3.1 Permitted Scenarios.....	6
5. Selected Scenarios.....	8
5.1 The Selection Process .....	8
5.2 Scenarios.....	8
5.2.1 Demand Contract.....	8
5.2.1.1 Simulation Scenario DC-1 .....	8
5.2.1.2 Simulation Scenario DC-2 .....	8
5.2.1.3 Simulation Scenario DC-5 .....	8
5.2.1.4 Simulation Scenario DC-6 .....	8
5.2.2 Periodic Contract.....	8
5.2.2.1 Simulation Scenario PC-1 .....	8
5.2.2.2 Simulation Scenario PC-5 .....	8
5.2.2.3 Simulation Scenario PC-6 .....	8
5.2.3 Event Contract .....	9
5.2.3.1 Simulation Scenario EC-1 .....	9
5.2.3.2 Simulation Scenario EC-5 .....	9
5.2.4 Miscellaneous .....	9
5.2.4.1 Simulation Scenario M-1 .....	9
5.2.4.2 Simulation Scenario M-2 .....	9

5.2.4.3 Simulation Scenario M-3 .....	9
6. Analysis and Interpretation of Results .....	10
6.1 Permitted Scenarios.....	10
6.1.1 Demand Contracts .....	10
6.1.1.1 Simulation Scenario DC-1 .....	10
6.1.1.2 Simulation Scenario DC-2 .....	10
6.1.1.3 Simulation Scenario DC-5 .....	10
6.1.1.4 Simulation Scenario DC-6 .....	10
6.1.2 Periodic Contracts.....	10
6.1.2.1 Simulation Scenario PC-1 .....	10
6.1.2.2 Simulation Scenario PC-5 .....	10
6.1.2.3 Simulation Scenario PC-6 .....	11
6.1.3 Event Contracts .....	11
6.1.3.1 Simulation Scenario EC-1 .....	11
6.1.3.2 Simulation Scenario EC-5 .....	11
6.1.4 Miscellaneous .....	11
6.1.4.1 Simulation Scenario M-1 .....	11
6.1.4.2 Simulation Scenario M-2 .....	11
6.1.4.3 Simulation Scenario M-3 .....	11
6.2 Conclusions .....	11
7. The Appropriateness of the Tools in SARPs Validation.....	12
7.1 Scenario Generation .....	12
7.2 Analysis of Results.....	12
ANNEX A. ADS SARPs Defects Found.....	13
ANNEX B. Message Sequence Charts.....	14

# **1. INTRODUCTION**

## **1.1 Scope of Document**

This document concerns itself with a programme of work to validate the ADS SARPs using a tool from Verilog called GEODE. The document makes initial conclusions on the SARPs validation work for inclusion at the ICAO meeting to be held in Brussels during April 1996.

This is an interim report presenting the results of the author's initial experience with the GEODE validation tool and the ADS SARPs model.

## **1.2 Background**

The validation of a SARPs, is part of the wider validation and verification work needed to progress a draft SARPs to full international status. This interim report addresses one technique that was used in the validation process, namely the use of automated tools, and is more fully described in the next section.

## **1.3 References**

1. Draft ADS SARPs for the ATN CNS/ATM-1 Package. Version 1, dated 6th October 1995.
2. Defect Reports (as provided by Verilog) dated 2nd January 1996.
3. Verilog's GEODE documentation set

## 2. VALIDATION METHODOLOGY

### 2.1 Background

The ADS SARPs was (graphically) modelled using a formal definition language called the Specification and Description Language (SDL) using tools supplied by Verilog. SDL is an internationally recognised language (ITU-T Z.100) that is mainly used for describing the behaviour of telecommunications systems.

The ADS model used as the basis for the validation work was developed against the version of the SARPs dated 6th October 1996 [1] with some corrections to take account of defects detected in the SARPs by Verilog [2] when developing the model.

The subsequent work, that is addressed by this document, was to develop a small set of scenarios that are used to exercise the model.

### 2.2 Scenario Development

The development of the scenarios and associated scripts to exercise the model was based upon the following steps:

- Cross-checking the model against the SARPs (See Section 3.2),
- Identification of a set of possible scenarios representing the majority of situations (See Section 4),
- Selection of a representative sub-set of these scenarios to test against the model (See Section 5),
- Generation of the scenarios and associated scripts (See Section 5),
- Running a simulation for each scenario (See Section 5),
- Analysis and Interpretation of results (See Section 6),
- Noting alleged defects and reporting these to the ADS SARPs Editor (See Annex A).

In addition Section 7 contains a brief report of the author's experience with the Verilog tools.

## 3. GEODE MODELLING - ADS

### 3.1 Base ADS SARPs Model

Verilog provided the base ADS SARPs model based on a Draft ADS SARPs [1]. This model ('cns.pr') is compiled (as shown below) and the simulation started. The start-up file provides an initial sequence of transitions that are required to place the model into a normal operation state.

For each scenario the user of the model triggers the necessary transitions and generates a trace of these (for future playback) together with a log file.

The development of the model follows the following sequence:

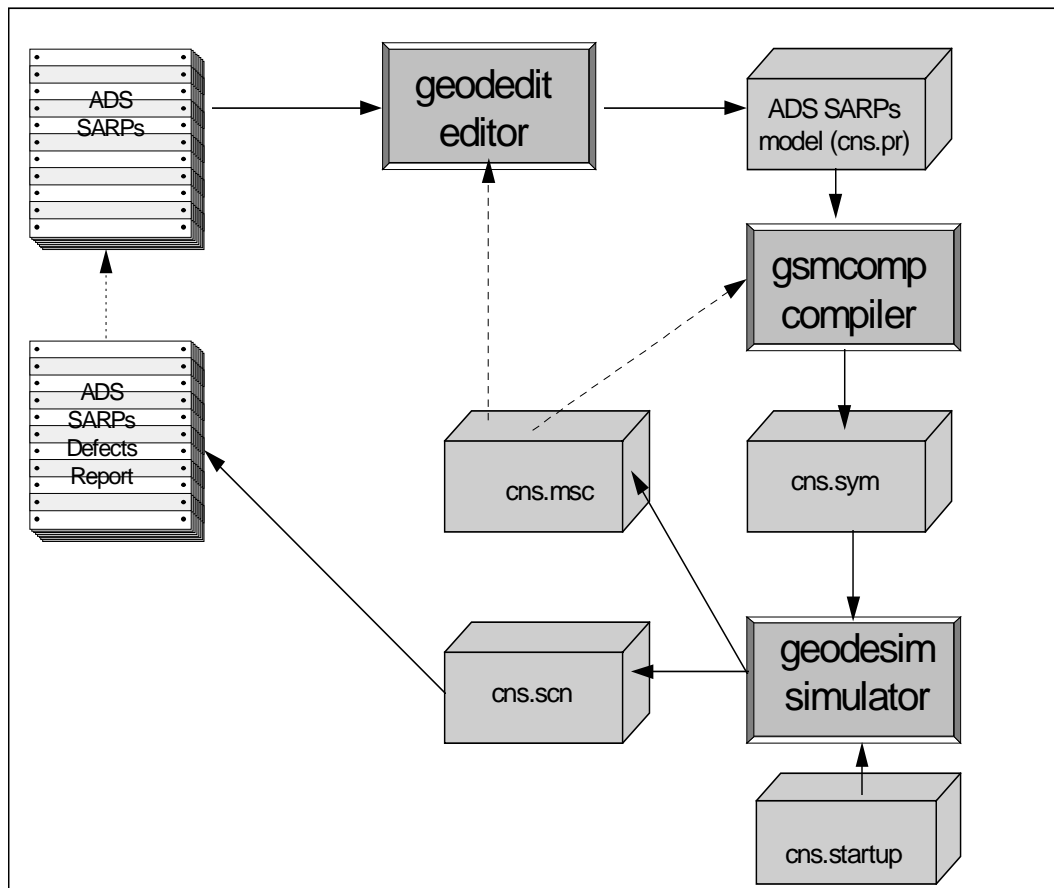
- Verilog used the Draft ADS SARPs [1] to produce the ADS SARPs model, using the GEODE editor (geodedit),
- The model is then compiled using the GEODE compiler (gsmcomp),
- An initial list of transitions is placed in a start-up file for convenience,

The model is now ready for running scenarios:

- For each scenario the model is run firing the transitions in order,
- When the scenario completes (or can proceed no further due to errors) the scenario is saved,
- The scenario can be converted into a message sequence chart for graphical viewing.

The outcome of each scenario is then used to determine:

- If the model is in error,
- If the ADS SARPs is in error (which will cause a defect report to be raised).



### 3.2 Cross-Checking the Model against the ADS SARPs

Throughout this task the model was cross-checked against the ADS SARPs in order to check the validity of the model.

The following deficiencies in the GEODE model have so far been located:

1. In the Ground HI module - only requests are handled, there are no indications or confirmations.
2. In the Air User module - periodic contracts are not handled.
3. User Abort - not available from air or ground.
4. Provider Abort - dysfunctional.

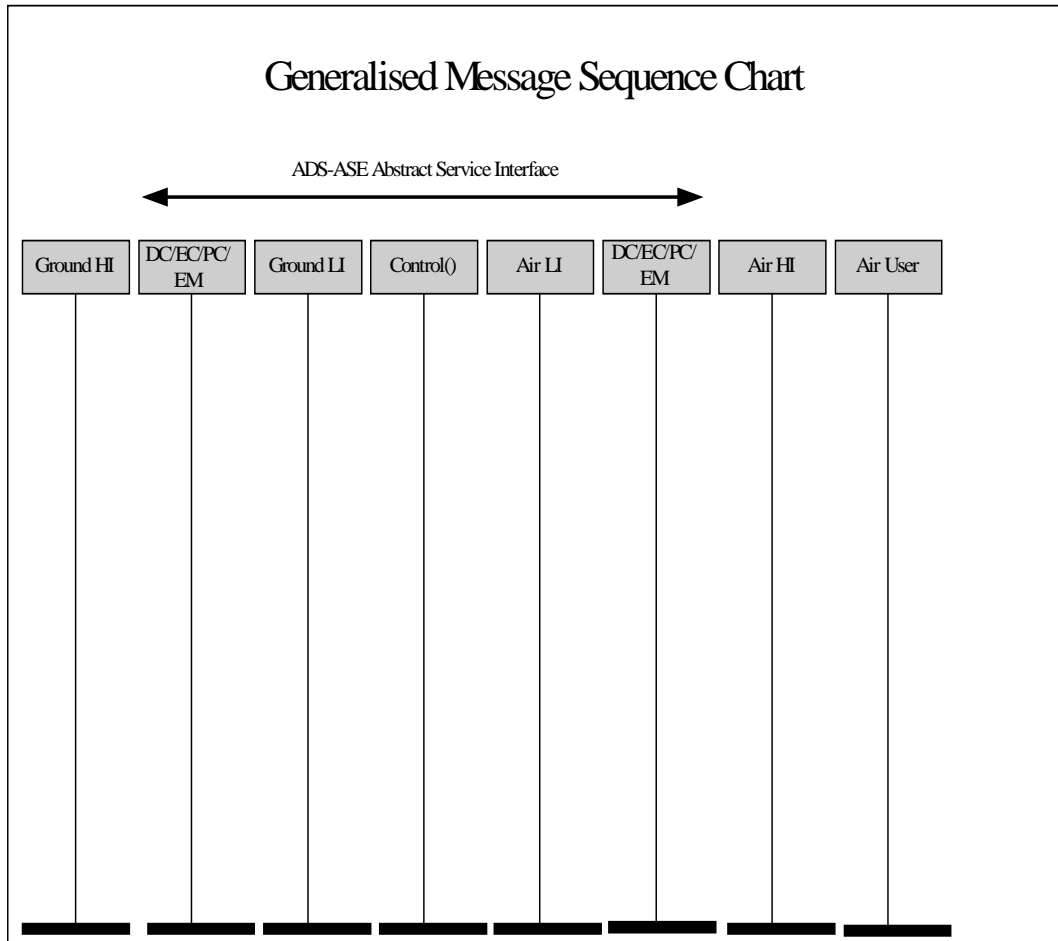
## 4. IDENTIFICATION OF POSSIBLE SIMULATION SCENARIOS

### 4.1 Introduction

This section identifies possible scenarios that can occur in the definition of the ADS SARPs, provided that both air and ground system conform to the specification.

### 4.2 Message Sequence Charts

The Verilog ADS SARPs model defines a number of entity instances, shown as processes in the following diagram.



The Message Sequence Charts for each scenario are attached in Annex B.

### 4.3 Simulation Scenarios

A number of simulations, as shown in the following table, could be performed, but time constraints will restrict the actual number that can be written.



### 4.3.1 Permitted Scenarios

#	Figure reference in [1]	Definition
DC-1	5-1	Demand Contract. No Dialogue existing. Positive Acknowledgement.
DC-2	5-3	Demand Contract. No Dialogue existing. Negative Acknowledgement.
DC-3	5-2	Demand Contract. With Dialogue existing. Positive Acknowledgement.
DC-4	5-4	Demand Contract. With Dialogue existing. Negative Acknowledgement.
DC-5	5-1 5-35	Scenario DC-1 with ground user abort (at some point).
DC-6	5-1 5-36	Scenario DC-1 with dialogue service provide abort (at some point).
PC-1	5-15 5-21	Periodic Contract. With Dialogue existing. Positive Acknowledgement. x * Periodic Reports Cancel Contract
PC-2	5-16 5-21	Periodic Contract. No Dialogue existing. Positive Acknowledgement. x * Periodic Reports Cancel Contract
PC-3	5-15	Periodic Contract. With Dialogue existing. Negative Acknowledgement.
PC-4	5-16	Periodic Contract. No Dialogue existing. Negative Acknowledgement
PC-5	5-15 5-16 5-21	Periodic Contract. No Dialogue existing. Positive Acknowledgement. x * Periodic Reports Periodic Contract. With Dialogue existing. Positive Acknowledgement. y * Periodic Reports Cancel Contract
PC-6	5-15 5-21 5-24 5-29	Periodic Contract. With Dialogue existing. Positive Acknowledgement. x * Periodic Reports Emergency Report (Air initiated) y * Emergency Reports End Emergency Report (Air initiated) z * Periodic Reports Cancel Contract
PC-7		Periodic Contract. No Dialogue existing. Positive Acknowledgement. x * Periodic Reports Demand Contract. With Dialogue existing. Positive Acknowledgement. y * Periodic Reports Cancel Periodic Contract
EC-1	5-7 5-21	Event Contract. No Dialogue existing. Positive Acknowledgement Event Report

#	Figure reference in [1]	Definition
		Cancel Event Contract
EC-2	5-8 5-21	Event Contract. With Dialogue existing. Positive Acknowledgement Event Report Cancel Event Contract
EC-3	5-13	Event Contract. With Dialogue existing. Negative Acknowledgement
EC-4	5-14	Event Contract. No Dialogue existing. Negative Acknowledgement
EC-5	5-7 5-21	Event Contract. No Dialogue existing. Positive Acknowledgement Event Report Event Contract. With Dialogue existing. Positive Acknowledgement Event Report Cancel Event Contract
M-1	5-2 5-16 5-21	Periodic Contract. No Dialogue existing. Positive Acknowledgement. x * Periodic Reports Demand Contract. With Dialogue existing. Positive Acknowledgement Cancel Periodic Contract
M-2	5-7 5-16 5-21	Periodic Contract. No Dialogue existing. Positive Acknowledgement. x * Periodic Reports Event Contract. With Dialogue existing. Positive Acknowledgement Event Report Cancel Periodic Contract Cancel Event Contract
M-3	Various	Periodic Contract. No Dialogue existing. Positive Acknowledgement. Event Contract. With Dialogue existing. Positive Acknowledgement x * Periodic Reports Event Report y * Periodic Reports w * Emergency Reports Cancel-all-Contracts

**5.**

## **5. SELECTED SCENARIOS**

### **5.1 The Selection Process**

In order to choose a manageable number of scenarios a simple selection process was used. This basically produced three sets of scenarios:

- Those most likely to occur in everyday use,
- A combination of the above,

### **5.2 Scenarios**

#### **5.2.1 Demand Contract**

##### **5.2.1.1 Simulation Scenario DC-1**

To simulate a demand contract (with no dialogue existing) being accepted (positive acknowledgement).

##### **5.2.1.2 Simulation Scenario DC-2**

To simulate a demand contract (with no dialogue existing) being rejected (negative acknowledgement).

##### **5.2.1.3 Simulation Scenario DC-5**

To simulate a demand contract (with no dialogue existing) being accepted (positive acknowledgement). A ground user abort is simulated after the demand contract indication.

##### **5.2.1.4 Simulation Scenario DC-6**

To simulate a demand contract (with no dialogue existing) being accepted (positive acknowledgement). A dialogue service provider abort is simulated after the demand contract indication.

#### **5.2.2 Periodic Contract**

##### **5.2.2.1 Simulation Scenario PC-1**

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement).

##### **5.2.2.2 Simulation Scenario PC-5**

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement). After the x reports are issued another periodic contract (using the existing dialogue) is sent and accepted (positive acknowledgement). After the y reports are issued the contract is cancelled.

##### **5.2.2.3 Simulation Scenario PC-6**

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement). After the transmission of x reports an air initiated emergency report is sent. This is followed by y emergency report before the cancel emergency reports command is issued. z periodic reports should follow and the scenario terminated by a cancel contract.

## 5.2.3 Event Contract

### 5.2.3.1 Simulation Scenario EC-1

To simulate a event contract (with no dialogue existing) being accepted (positive acknowledgement).

### 5.2.3.2 Simulation Scenario EC-5

To simulate two interlaced event contracts (with no dialogue existing) being accepted (positive acknowledgement).

## 5.2.4 Miscellaneous

### 5.2.4.1 Simulation Scenario M-1

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement). While periodic reports are being issued a demand contract shall be established (with a positive acknowledgement).

### 5.2.4.2 Simulation Scenario M-2

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement). While periodic contract are being issued an event contract shall be established (with positive acknowledgement). After an event report is issued the periodic contract is cancelled followed by cancellation of the event contract.

### 5.2.4.3 Simulation Scenario M-3

To simulate a periodic contract (with no dialogue existing) being accepted (positive acknowledgement). While periodic contract are being issued an event contract shall be established (with positive acknowledgement). An event report is issued followed by more periodic reports and a number of emergency reports. Finally a cancel-all-contracts command is issued.

## 6.

## **6. ANALYSIS AND INTERPRETATION OF RESULTS**

### **6.1 Permitted Scenarios**

#### **6.1.1 Demand Contracts**

##### **6.1.1.1 Simulation Scenario DC-1**

The results of this scenario are shown in figure 1 in Annex B. The ADS-demand-contract request was correctly followed by an ADS-demand-contract indication and an ADS-demand-contract response. No ADS-demand-contract confirmation was given. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 1 in Section 3.2) and the SARPs is correct.

##### **6.1.1.2 Simulation Scenario DC-2**

The results of this scenario are shown in figure 2 in Annex B. The ADS-demand-contract request was correctly followed by an ADS-demand-contract indication and an ADS-demand-contract response. No ADS-demand-contract confirmation was given. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 1 in Section 3.2) and the SARPs is correct.

##### **6.1.1.3 Simulation Scenario DC-5**

The results of this scenario are shown in figure 3 in Annex B. The ADS-demand-contract request was correctly followed by an ADS-demand-contract indication and an ADS-demand-contract response. The model is deficient as it did not allow a ADS-User-Abort to be issued. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 3 in Section 3.2) and the SARPs is correct.

##### **6.1.1.4 Simulation Scenario DC-6**

The results of this scenario are shown in figure 4 in Annex B. The ADS-demand-contract request was correctly followed by an ADS-demand-contract indication and an ADS-demand-contract response. The model did allow an ADS-Provider-Abort to be issued but the behaviour beyond this point was dysfunctional. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 4 in Section 3.2) and the SARPs is correct.

#### **6.1.2 Periodic Contracts**

##### **6.1.2.1 Simulation Scenario PC-1**

The results of this scenario are shown in figure 5 in Annex B. The ADS-periodic-contract request was correctly followed by an ADS-periodic-contract indication. However the model is deficient in that periodic contracts are not handled by the air user. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 2 in Section 3.2) and the SARPs is correct.

##### **6.1.2.2 Simulation Scenario PC-5**

The results of this scenario are shown in figure 6 in Annex B. The ADS-periodic-contract request was correctly followed by an ADS-periodic-contract indication. However the model is deficient in that periodic contracts are not handled by the air user. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 2 in Section 3.2) and the SARPs is correct.

### 6.1.2.3 Simulation Scenario PC-6

The results of this scenario are shown in figure 7 in Annex B. The ADS-periodic-contract request was correctly followed by an ADS-periodic-contract indication. However the model is deficient in that periodic contracts are not handled by the air user. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 2 in Section 3.2) and the SARPs is correct.

### 6.1.3 Event Contracts

#### 6.1.3.1 Simulation Scenario EC-1

The results of this scenario are shown in figure 8 in Annex B. The ADS-event-contract request was correctly followed by an ADS-event-contract indication and an ADS-event-contract response. No ADS-event-contract confirmation was given. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 1 in Section 3.2) and the SARPs is correct.

#### 6.1.3.2 Simulation Scenario EC-5

The results of this scenario are shown in figure 9 in Annex B. The ADS-event-contract request was correctly followed by an ADS-event-contract indication and an ADS-event-contract response. No ADS-event-contract confirmation was given. Analysis of the SARPs and the model showed that the model is deficient (See Deficiency 1 in Section 3.2) and the SARPs is correct.

### 6.1.4 Miscellaneous

#### 6.1.4.1 Simulation Scenario M-1

\*\* TBC

#### 6.1.4.2 Simulation Scenario M-2

\*\* TBC

#### 6.1.4.3 Simulation Scenario M-3

\*\* TBC

## 6.2 Conclusions

The defects in the model have been a severe impediment to the validation work. All that can be concluded is that those parts of the model that correctly implement the draft ADS SARPs show that the message sequences shown in the draft ADS SARPs can be generated by the protocol model.

It is also noted that the current version of the draft ADS SARPs is not the same as that modelled.

It is recommended that the ADS model be updated:

- a) To correct the defects found, and
- b) To bring it in line with the latest version of the draft SARPs.

Following this, the generation of the scenarios presented in this paper can be completed.

## 7.

## **7. THE APPROPRIATENESS OF THE TOOLS IN SARPs VALIDATION**

\*\* TBC

### **7.1 Scenario Generation**

\*\* TBC

### **7.2 Analysis of Results**

\*\* TBC

## **Annex A      ADS SARPs Defects Found**

\*\* TBC



## **Annex B    Message Sequence Charts**

The following results are attached:

Figure-1: Simulation Scenario DC-1 'dc\_pos.msc'

Figure-2: Simulation Scenario DC-2 'dc\_neg.msc'

Figure-3: Simulation Scenario DC-5 'dc\_ua.msc'

Figure-4: Simulation Scenario DC-6 'dc\_pa.msc'

Figure-5: Simulation Scenario PC-1 'pc.msc'

Figure-6: Simulation Scenario PC-5 'pc.msc'

Figure-7: Simulation Scenario PC-6 'pc.msc'

Figure-8: Simulation Scenario EC-1 'ec.msc'

Figure-9 Simulation Scenario EC-5 'ec.msc'