# The 2nd UMTS FemtoCell Plugfest;
# Sophia Antipolis, France;
# 24-28 January 2011



***ETSI***

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# Contents

# 1 Executive Summary

The 2nd UMTS FemtoCell Plugfest event was held from 24 to 28 January 2011 in Sophia Antipolis (France).

This event, which was co-organized by ETSI and the Femto Forum, aimed to test the interoperability between HNB (Home NodeB) and HMS (Home NodeB Management System) equipment.

This event required a very detailed preparation in order to allow the communication between network component located at remote sites, and the vendor implementations operating in the Plugfest premises.

14 companies participated in this event executing more than 300 interoperability tests.

Despite the fact that vendor's could not run all foreseen tests, and given that this was the first event for HMS – HNB interoperability, a high percentage of interoperabilitywas achieved. This result shows the high level of maturity of the FemtoCell technology.

In addition informal Iuh staging tests were executed by a number of participants. The tests were executed in preparation for the 3rd FemtoCell event in April 2011.

# 2 Introduction

This Plugfest event aimed to verify the interoperability between FemtoCell products from different vendors.

The FemtoCell technology is using several different components. This Plugfest event focused on the following types of equipment:

- Femto access points (FAP), also named interchangeably Home Node B (HNB),
- Security Gateways (SeGW),
- Femto Gateways (FGW), also named interchangeably Home Node B Gateways (HNB-GW),
- HMS (Home NodeB Management System)

All HNBs were provided by vendors at the Plugfest premises, in Sophia Antipolis. But the Gateways (either SeGW or HNB-GW) and HMS were partly located at vendor's premises. This fact had to be taken into account during the event preparation.

# 3 Abbreviations

| | |
|---|---|
| FAP: | Femto Access Point |
| FGW: | Femto GateWay |
| HIVE: | Hub for Interoperability and Validation at ETSI |
| HNB: | Home Node B |
| HNB-GW: | Home Node B GateWay |
| HMS: | Home NodeB Management System |
| NO: | Test is recorded as NOT successfully passed. |
| NA: | Test is not applicable. |
| OK: | Test is recorded as successfully passed. |
| OT: | Test is recorded as not being executed due to lack of time. |
| SeGW: | Security GateWay |
| Test Session: | A paring of vendors that test together during a given time slot. |
| TSR: | Test Session Report. Report created during a test session. |

# 4 Participants

The companies, who contributed to the test result are listed in the table below. The companies are accordingly to the types and the combination of Femto components they provided.

**Table 1: the participating companies**

| HNB | Company Name |
|---|---|
| | Ablaze Wireless |
| | Alpha Networks Inc. |
| | Argela |
| | Askey Computer Corporation |
| | Networks & Multimedia Institute, Institute for Information Industry |
| | Node-H GmbH |
| | Picochip |
| | Ubiquisys Ltd |
| SeGW | Company Name |
| | Acme Packet |
| HMS | Company Name |
| | Alcatel-Lucent |
| HNB GW | Company Name |
| | IntelliNet Technologies, Inc. |
| SeGW + HNB GW + HMS | Company Name |
| | NEC Europe Ltd. |
| | Nokia Siemens Networks Oy |
| | Huawei |

# 5 Technical and Project Management

## 5.1 Test Plan

The test plan concentrated on the interoperability between HNB (Home NodeB) and HMS (Home NodeB Management System) equipment as this was the primary objective of the 2nd UMTS FemtoCell Plugfest event. However, seven test scenarios from the 1st UMTS FemtoCell Plugfest related to the security aspects of the interworking between HNB and

SeGW (Security Gateway) equipment were explicitly included into the test plan. Running those tests was seen as an essential pre-requisite to testing the HMS - HNB procedures.

The test plan was developed in collaboration with the Femto Forum. Feedback was collected during the eight conference calls that were held in preparation to the plugfest event. The lively discussions during the conference calls led to a robust test document that was agreed on by all plugfest participants. The final version of the HMS related test plan is comprised of 35 test cases each providing a complete description of an interoperability test scenario.

The following table shows the test scenarios, grouped by protocol features. The test group “Security” contains the above mentioned seven test cases from the earlier plugfest:

**Table 1: Test plan for the 2nd UMTS FemtoCell Plugfest**

| Group | TD Identifier | Summary |
|---|---|---|
| Security | SEC/FSG/01 | FAP – SeGW Crypto Profile Configuration and Basic Tunnel Establishment |
| | SEC/FSG/02 | Use of NAT-T |
| | SEC/FSG/03 | Use of NAT-T – Dynamic Address Change |
| | SEC/FSG/04 | DPDs |
| | SEC/FSG/05 | IKE and IPsec SA Rekeying |
| | SEC/FSG/06 | Tunnel Deletion |
| | SEC/FSG/07 | FAP Reboot |
| Provisioning signalling flow | TC_HMS_01 | HNB bootstraps with HMS |
| | TC_HMS_02 | HMS requests connection with HNB |
| | TC_HMS_03 | HNB requests connection with HMS |
| | TC_HMS_04 | HMS retrieves IMSI from HNB |
| | TC_HMS_05 | HMS checks HNB self-configuration profile |
| | TC_HMS_06 | HMS starts configuring femto-cell |
| | TC_HMS_07 | HMS triggers radio environment monitoring |
| | TC_HMS_08 | HMS sets up HNB profiles - UMTSCellConfigBaseline |
| | TC_HMS_09 | HMS sets up HNB profiles – UMTSCellConfigNLIntraFreqCell (not HNB self-configured) |
| | TC_HMS_10 | HMS sets up HNB profiles –UMTSCellConfigNLIntraFreqCell (HNB self-configuration) |
| | TC_HMS_11 | HMS sets up HNB profiles – UMTSCellConfigNLInterFreqCell (not HNB self-configured) |
| | TC_HMS_12 | HMS sets up HNB profiles –UMTSCellConfigNLInterFreqCell (HNB self-configuration) |
| | TC_HMS_13 | HMS sets up HNB profiles – UMTSCellConfigNLInterRATCell (not HNB self-configured) |
| | TC_HMS_14 | HMS sets up HNB profiles –UMTSCellConfigNLInterRATCell (HNB self-configuration) |
| | TC_HMS_15 | HMS sets up HNB profiles – ACL(open mode) |
| | TC_HMS_16 | HMS sets up HNB profiles – ACL(closed mode) |
| | TC_HMS_17 | HMS sets up HNB profiles – ACL(hybrid mode) |
| | TC_HMS_18 | HMS sets up HNB profiles – UMTSCellConfigAdvanced |
| | TC_HMS_19 | HMS sets up HNB profiles –AdminState |
| Factory reset | TC_HMS_20 | HMS triggers factory reset procedure for HNB |
| SW image download | TC_HMS_21 | Download |
| Performance management | TC_HMS_22 | Performance management |
| Alarm management | TC_HMS_23 | Fault management |
| Other profiles | TC_HMS_24 | Time |
| | TC_HMS_25 | QoS (This test case shall not be executed in plugfest #2) |
| | TC_HMS_26 | UMTSCellConfigUEInternalMeasurement |
| | TC_HMS_27 | LocalIPAccess (This test case shall not be executed in plugfest #2) |
| | TC_HMS_28 | GPS |
| | TC_HMS_29 | TransportSCTP |
| | TC_HMS_30 | TransportRealTime |
| | TC_HMS_31 | IPsecTunnel |
| | TC_HMS_32 | UMTSSelfConfigNLInUseIntraFreqCell |
| | TC_HMS_33 | UMTSSelfConfigNLInUseInterFreqCell |
| | TC_HMS_34 | UMTSSelfConfigNLInUseInterRATCell |
| | TC_HMS_35 | UMTSCellConfigFreqMeasurement |

In addition to the above test plan the test cases from the 1st FemtoCell plugfest were also available and were used by several companies for staging testing in preparation for the 3rd FemtoCell plugfest scheduled for April 2011.

## 5.2 Test Scheduling

The preliminary test schedule was developed before the plugfest event and was circulated to all the participants in advance for comments. Due to the fact that there were 4 HMS vendors present to test against 8 HNB vendors, the HMS part of the sessions was split into a primary and a secondary session. The HNB vendor in the primary session received

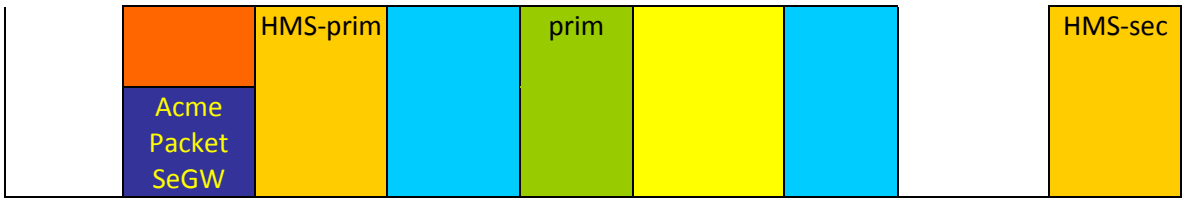
full support from the HMS vendor whereas the HNB vendors in the secondary session received a lesser support and used the test slot for preparation or repetition of test cases. This concept proved to be useful as it avoided that HNB vendors had empty test slots without activity.

The test schedule was constantly adopted according to the progress of the plugfest test sessions. This was done during the daily wrap-up meetings at the end of each day and during face-to-face meetings with the participants.

Following the test schedule which demonstrates that all vendors had the chance to test against each other.

| Mon 24 | Area1 | Area2 | Area3 | Area4 | Area5 | Area6 | Area7 | Area8 | Area9 |
|---|---|---|---|---|---|---|---|---|---|
| 9:00-13:00 | Picochip HNB | Node-H HNB | III HNB-A | | Ablaze Wireless HNB | Huawei HMS-sec | Ubiquisys HNB | Alpha Networks HNB | Argela HNB |
| | Huawei HMS-prim | Alcatel-Lucent HMS-prim | NSN HMS-prim | | NEC HMS-prim | III HNB-B | Alcatel-Lucent HMS-sec | NSN HMS-sec | NEC HMS-sec |
| 14:00-18:00 | Alpha Networks HNB | Askey HNB | Ubiquisys HNB | Argela HNB | Node-H HNB | | Alcatel-Lucent HMS-sec | Picochip HNB | Ablaze Wireless HNB |
| | NEC HMS-prim | NSN HMS-prim | Alcatel-Lucent HMS-prim | Huawei HMS-prim | IntelliNet HNB-GW | | III HNB-B | NSN HMS-sec | Huawei HMS-sec |
| | | | | | Acme Packet SeGW | | | | |

| Tue 25 | Area1 | Area2 | Area3 | Area4 | Area5 | Area6 | Area7 | Area8 |
|---|---|---|---|---|---|---|---|---|
| 8:30-12:30 | Alpha Networks HNB | Node-H HNB | Ubiquisys HNB | Argela HNB | Ablaze Wireless HNB | Picochip HNB | III HNB-A | Askey HNB |
| | IntelliNet HNB-GW | | | | | | | |
| | Acme Packet SeGW | NEC HMS-prim | Huawei HMS-prim | Alcatel-Lucent HMS-prim | NSN HMS-prim | Alcatel-Lucent HMS-sec | NEC HMS-sec | NSN HMS-sec |
| 13:30-17:30 | Askey HNB | Picochip HNB | Argela HNB | III HNB-B | Alpha Networks HNB | Node-H HNB | | Ubiquisys HNB |
| | IntelliNet HNB-GW | Alcatel-Lucent | NSN HMS-prim | NEC HMS- | Huawei HMS-prim | NSN HMS-sec | | Alcatel-Lucent |




| Wed 26 | Area1 | Area2 | Area3 | Area4 | Area5 | Area6 | Area7 | Area8 | Area9 |
|---|---|---|---|---|---|---|---|---|---|
| 9:00-13:00 | Ubiquisys HNB | Node-H HNB | Askey HNB | III HNB-A | Ablaze Wireless HNB | Alpha Networks HNB | Argela HNB | III HNB-B | |
| | IntelliNet HNB-GW<br>Acme Packet SeGW | NSN HMS-prim | Alcatel-Lucent HMS-prim | NEC HMS-prim | Huawei HMS-prim | Alcatel-Lucent HMS-sec | NEC HMS-sec | NSN HMS-sec | |
| 14:00-18:00 | III HNB-A | Picochip HNB | III HNB-B | Alpha Networks HNB | Ablaze Wireless HNB | Askey HNB | | Ubiquisys HNB | Argela HNB |
| | Huawei HMS-prim | NEC HMS-prim | Alcatel-Lucent HMS-prim | NSN HMS-prim | IntelliNet HNB-GW<br>Acme Packet SeGW | NEC HMS-sec | | NSN HMS-sec | Alcatel-Lucent HMS-sec |

| Thu 25 | Area1 | Area2 | Area3 | Area4 | Area5 | Area6 | Area7 | Area8 |
|---|---|---|---|---|---|---|---|---|
| 9:00-13:00 | Argela HNB | Picochip HNB | III HNB-B | Ablaze Wireless HNB | III HNB-A | Node-H HNB | Alpha Networks HNB | |
| | NEC HMS-prim | NSN HMS-prim | Huawei HMS-prim | Alcatel-Lucent HMS-prim | IntelliNet HNB-GW / Acme Packet SeGW | NEC HMS-sec | NSN HMS-sec | |
| 14:00-18:00 | Askey HNB | Ubiquisys HNB | Argela HNB | III HNB-A | III HNB-B | Ablaze Wireless HNB | Node-H HNB | Picochip HNB |
| | Huawei HMS-prim | NEC HMS-prim | IntelliNet HNB-GW / Acme Packet SeGW | Alcatel-Lucent HMS-prim | NSN HMS-prim | NSN HMS-sec2 | Alcatel-Lucent HMS-sec | NSN HMS-sec1 |

| Fri 28 | Area1 | Area2 | Area3 | Area4 | Area5 | Area6 | Area7 | Area8 |
|---|---|---|---|---|---|---|---|---|
| 9:00-13:00 | III HNB-B | Node-H Argela/ PicoChip HNB | Askey HNB | Ubiquisys HNB | Alpha Networks HNB | | Ablaze Wireless HNB | III HNB-A |
| | IntelliNet HNB-GW / Acme Packet SeGW | Huawei HMS-prim | NEC HMS-prim | NSN HMS-prim | Alcatel-Lucent HMS-prim | | NEC HMS-sec | Alcatel-Lucent HMS-sec |

## 5.2 Test Bed

Due to the fact that a similar testbed architecture had already been used during the 1st FemtoCell plugtest did the preparation of the test infrastructure not require an excessive amount of resource. This is despite the fact that the test environement in use was of a significant complexity, in particular:

- The HMS providers participating in the Plugfest event used equipment remotely located in their premises and needed reliable connections to the equipment on site in the Plugfest venue, either via a dedicated site-to-site VPN tunnel or via IPsec tunnels established by vendors SeGWs.
- In order to simulate an IP network, which is similar to a residential Home network, it was required to provide separate independent IP subnets to all HNBs.

The following figure shows the test bed, which was deployed during the Plugtests event and took the above requirements into account:

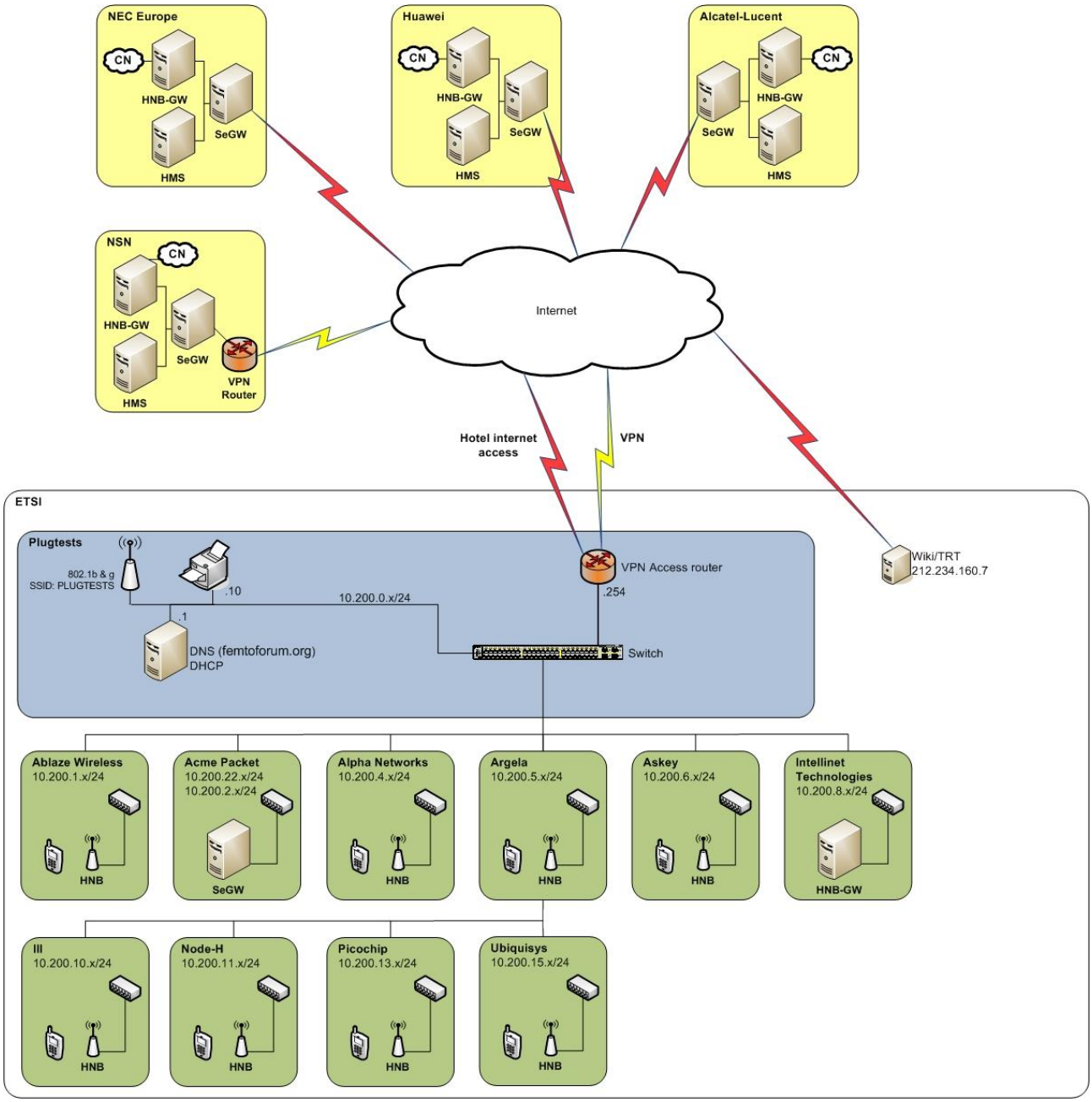



**Figure 1: Local and remote connections to the 2nd FemtoCell plugfest**

ETSI installed the HIVE-Nomad environment at the plugfest venue as it provides the taylor made solution for interoperability events, especially for large numbers of participants and in case of the need for secure IP connections. The following figure shows this environment:

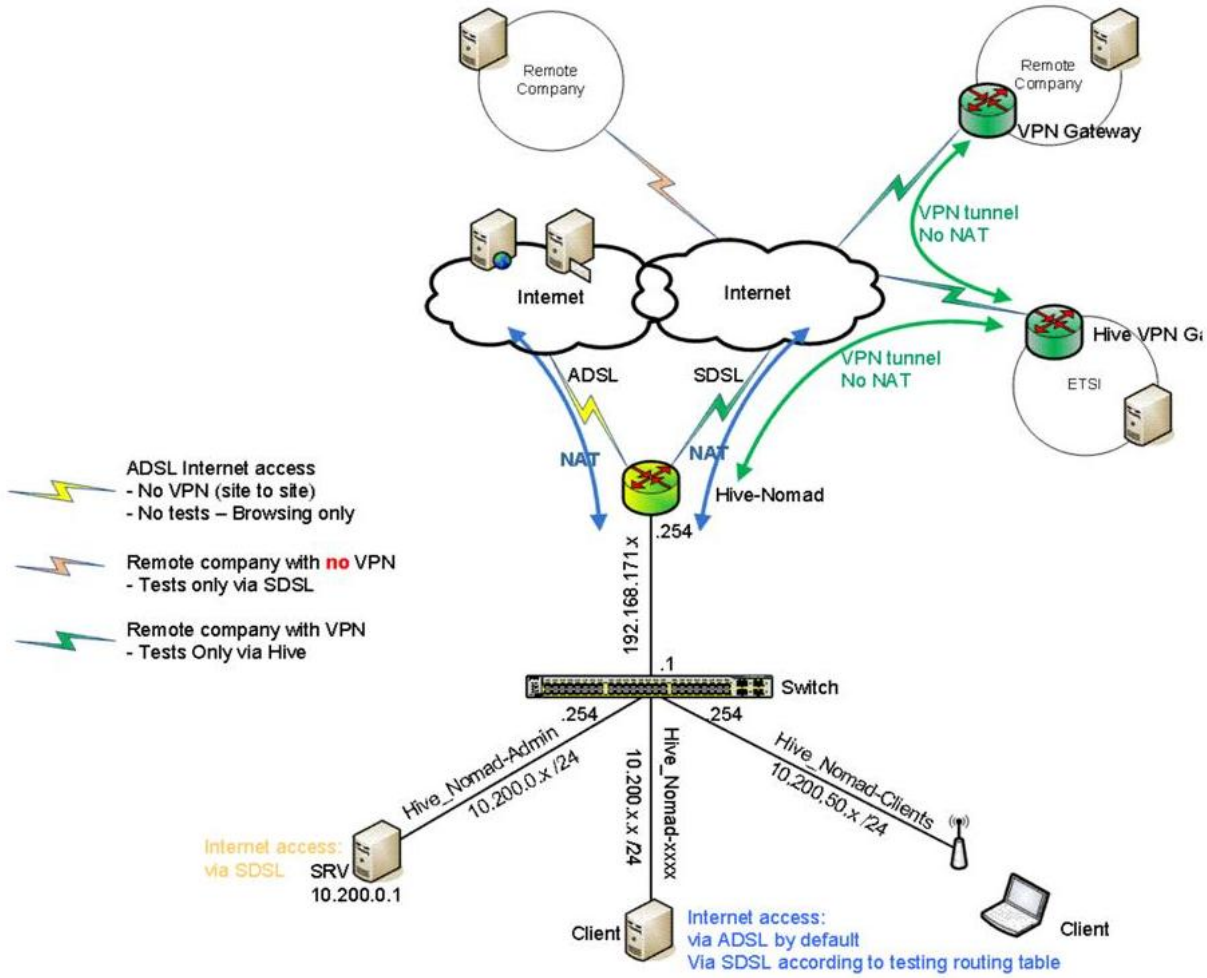



**Figure 2: Testbed environment for the 2nd FemtoCell plugfest**

## 5.3 Security Certificates

USIM Authentication was not used. The Iuh connection was secured with |IPSec. Before the event the equipment vendors provided information related to the security certificates which the HNB equipment needed to authenticate against the SeGW. The information was delivered to ETSI which created and delivered the certificates. Only two HNB vendors choose the option to create their own security certificate.

# 6 Achieved Results

## 6.1 Pre-testing

All vendors were invited to attend a 2 days pre-testing session on January 22 and 23 to avoid delays during the scheduled sessions that followed the pre-testing. This pre-testing was necessary due to the complexity of the test environment, in order to verify the IP security features and to check the basic Femto Cell features prior to the execution of the interoperability test sessions.

During the pre-testing sessions the vendors had the opportunity to configure their equipment on the test bed and to resolve basic interconnection problems with their implementations. This helped to ensure a seamless participation in the scheduled test sessions.

## 6.2 HMS Result Overview

Table 2 and figure 3 show a summary of the test results recorded with the Test Reporting Tool, during the test pairing sessions. TC_HMS_25 and TC_HMS_27 were excluded from the test execution and should be taken into account in a later plugfest. A totoal of 33 tests were available for execution. A total of 34 test sessions were recorded, which leaded to a total of tota1 of 1122 tests available for execution during the event.

11% were recorded as Not Applicable and could not be executed due to the unavailability of the feature under test in one of the test session participants equipment. The tests not applicable where mainly :

- TC_HMS_10: HMS sets up HNB profiles –UMTSCellConfigNLIntraFreqCell (HNB self-configuration),
- TC_HMS_12: HMS sets up HNB profiles –UMTSCellConfigNLInterFreqCell (HNB self-configuration)
- TC_HMS_14: HMS sets up HNB profiles –UMTSCellConfigNLInterRATCell (HNB self-configuration)
- TC_HMS_25: HMS and HNB profiles – QoS
- TC_HMS_27: HMS and HNB profiles – LocalIPAccess
- TC_HMS_28: HMS and HNB profiles – GPS

56% were recorded as Out of Time.

35% tests were executed tests. This precentage may seem low but given that

- this was the first event for HMS – HNB interoperability,
- a high number of tests were defined (35 compared to 18 tests in plugfest#1),
- a restricted time per test session,

and given that

- a full range of available tests was executed, and most of the HNB executed the provisioning flow tests,
- high percentage of interoperability OK results,

it is a very good result and proves that the objective of this plugfest event has been achieved.

From the executed tests, there are less than 1% of not OK results. This shows that the FemtoCell equipments present at the plugfest event are already very mature and proved to be nearly 100% interoperable.

Future plugfest events should concentrate on reducing the number of not executed tests and thereby further widening the overall test coverage.

**Table 2: HMS - HNB interoperability test results**

| Interoperability Result | | Execution Statistic | | |
|---|---|---|---|---|
| OK | not OK | Not Applicable | Out of Time | Run |
| **390 (99.7%)** | **1 (0.3%)** | **119 (10.6%)** | **612 (54.5%)** | **391 (34.8%)** |

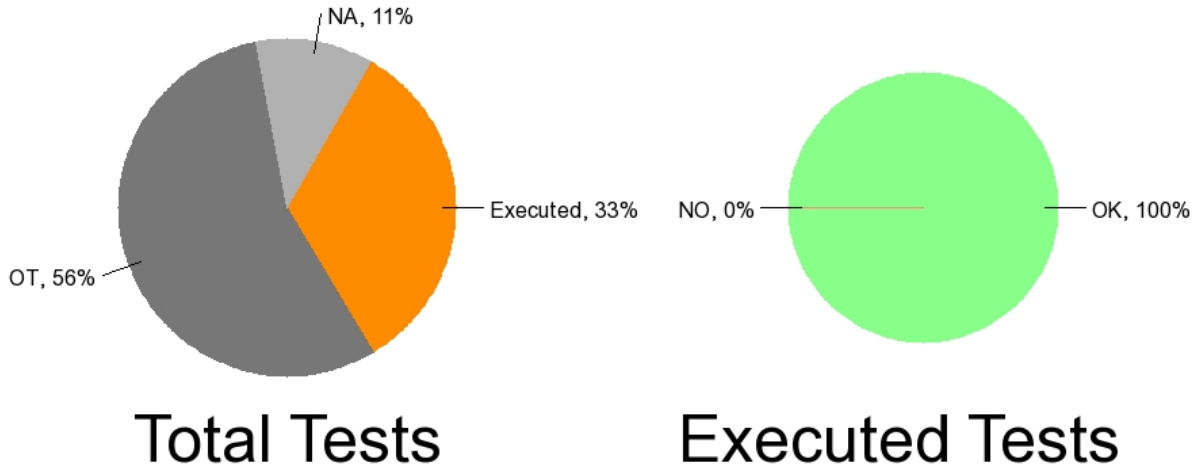



**Figure 3: HMS - HNB interoperability test results pie chart**

### 6.2.1 Results per HMS test

The figure below lists all tests, and shows the OK percentage of all submitted tests. All of the executed tests achieved a very high interoperability.

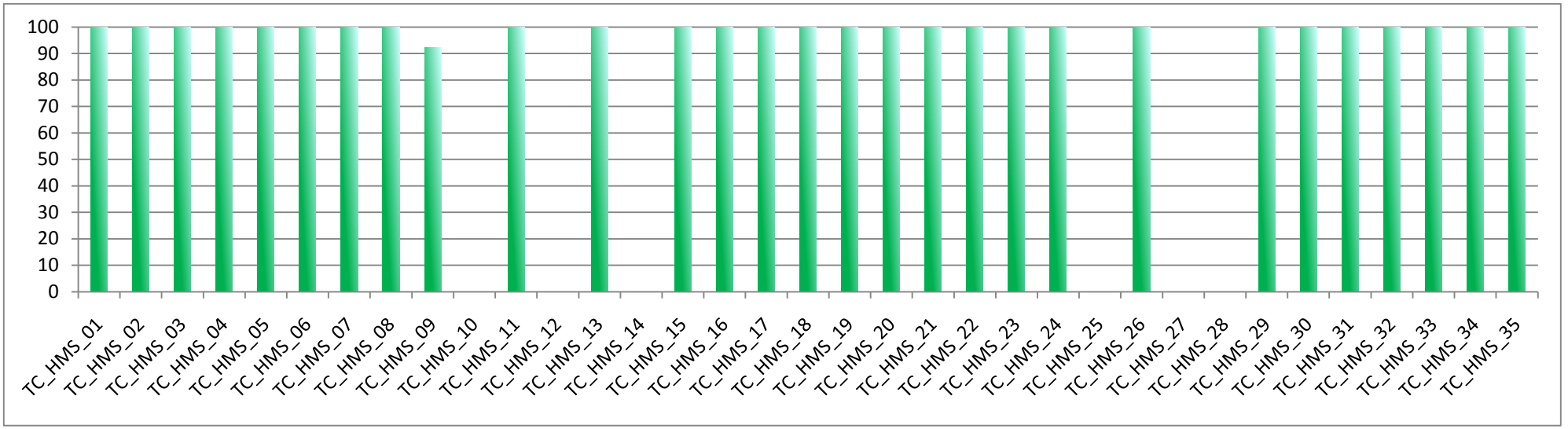



**Figure 4: Results per HMS test**

### 6.2.2 Execution coverage per HMS test

The figure below lists all tests, and shows the execution rate (=ratio of executed tests to tests available for execution). TC_HMS_10,12,14,25,27,28 were not executed at all. The test objectives of these tests are

- TC_HMS_10: HMS sets up HNB profiles –UMTSCellConfigNLIntraFreqCell (HNB self-configuration),
- TC_HMS_12: HMS sets up HNB profiles –UMTSCellConfigNLInterFreqCell (HNB self-configuration)
- TC_HMS_14: HMS sets up HNB profiles –UMTSCellConfigNLInterRATCell (HNB self-configuration)
- TC_HMS_25: HMS and HNB profiles – QoS
- TC_HMS_27: HMS and HNB profiles – LocalIPAccess
- TC_HMS_28: HMS and HNB profiles – GPS

For a future event support of these features shoudl be ensured.

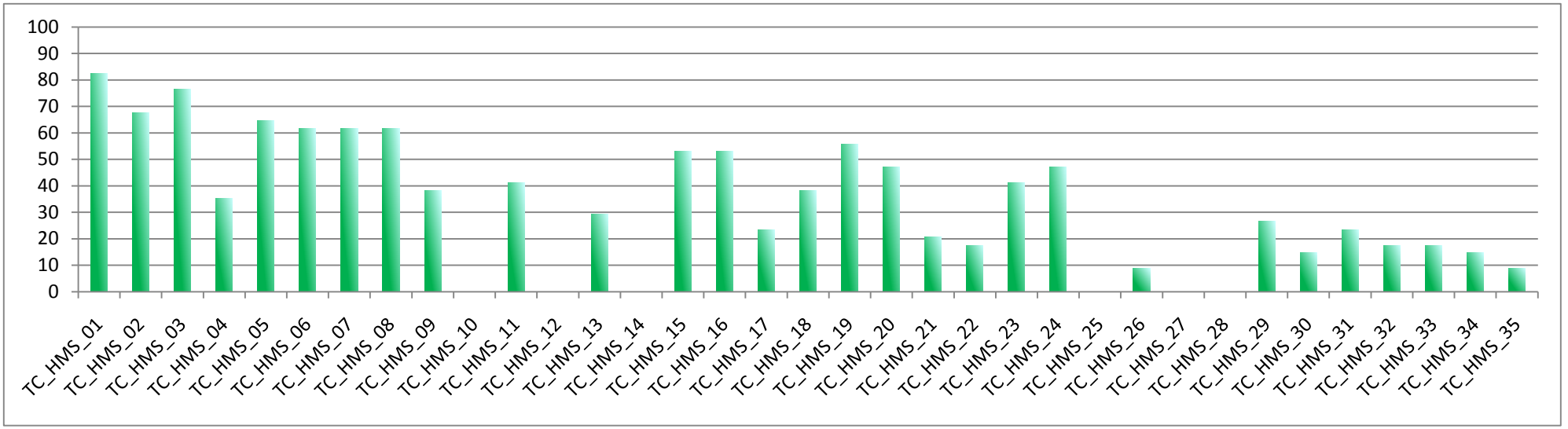



**Figure 5: Execution coverage per HMS test**

## 6.3 SEC_ONLY Result Overview

Table 3 and figure 6 show the results for the 7 security tests that were considered an essential pre-requisite for HMS – HNB interoperability. The high number of interoperability results and the fact that nearly 3 three quarters of the test were run shows the maturity of the equipments present at the plugfest event.

**Table 3: Security test results**

| Interoperability Result | | Execution Statistic | | |
|---|---|---|---|---|
| OK | not OK | Not Applicable | Out of Time | Run |
| **114 (98.3%)** | **2 (1.7%)** | **6 (3.7%)** | **39 (24.2%)** | **116 (72.0%)** |

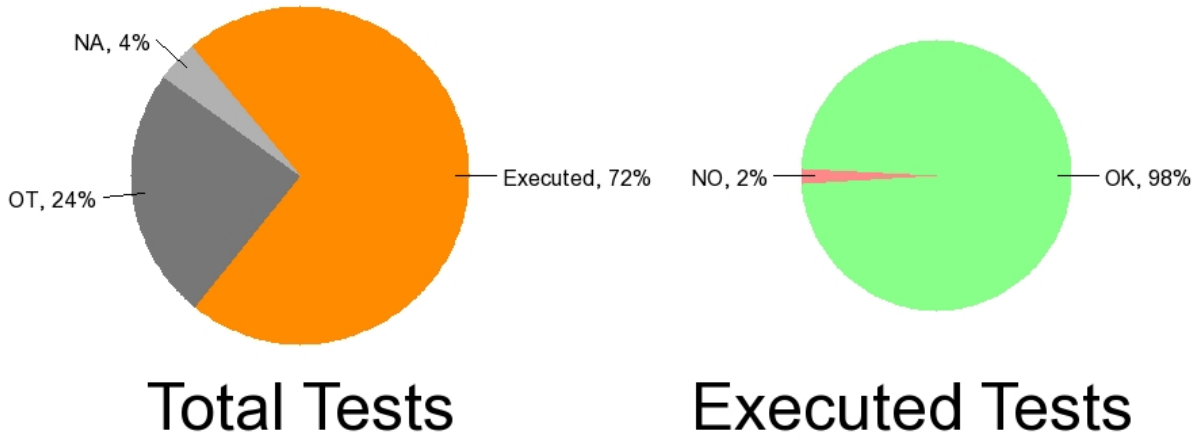



**Figure 6: Security test results pie chart**

### 6.3.1 Results per SEC_ONLY test

The figure below lists all tests, and shows the OK percentage of all submitted tests.

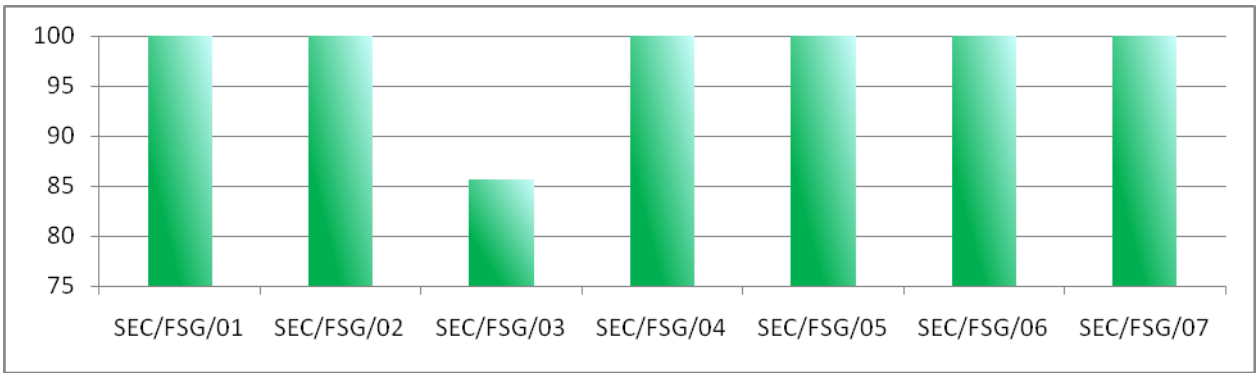



**Figure 7: result per SEC_ONLY test**

## 6.4 Results from Informal Iuh Staging Tests

Table 4 and figure 8 present the results of the informal Iuh staging tests that were executed by a number of participants. The tests were executed in preparation to the 3rd FemtoCell event in April 2011. The results below are shown for information only as they do not form an integral part of the objective of the 2nd FemtoCell plugfest event.

**Table 4: Informal Iuh Staging test results**

| Interoperability Result | | Execution Statistic | | |
|---|---|---|---|---|
| OK | not OK | Not Applicable | Out of Time | Run |
| **21 (95.5%)** | **1 (4.5%)** | **7 (8.0%)** | **59 (67.0%)** | **22 (25.0%)** |

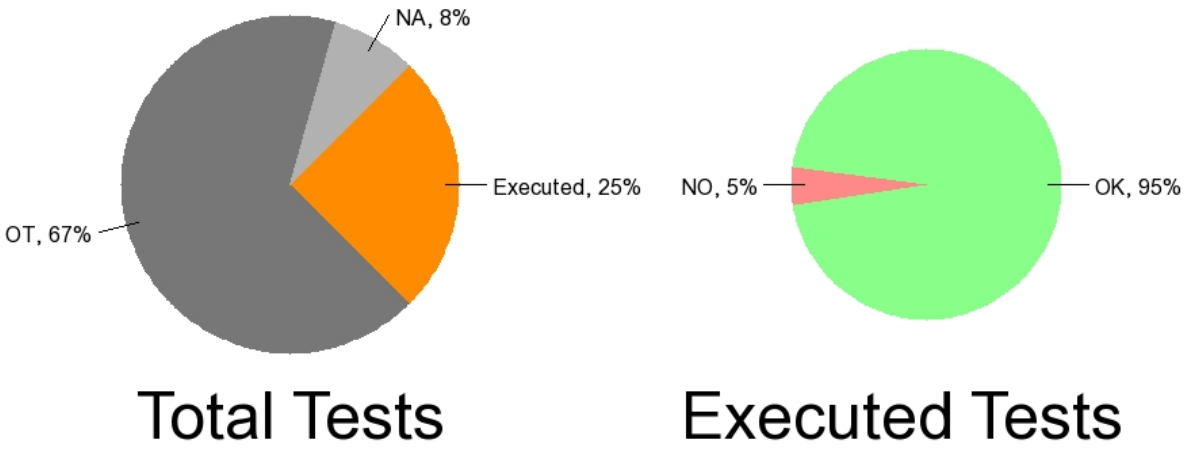



**Figure 8: Informal Iuh Staging test results pie chart**

## 6.5 Summary of Wrap Up Sessions

After each testing day a wrap up session took place where the plugfest participants could put forward issues on which they liked to open a discussion with the other participants. Topics were usually sent during the days to the technical coordinator of the event who collected the issues for discussion and published them on the plugfest event's wiki pages.

Besides discussions on the practical details of the test sessions like how to achieve certain behavior (e.g. how to force a NAT address change) and the scheduling for the following day, issues were raised on ambiguities of the base standards, namely TR69 and TR196.

Examples:

TR-196:

Quote, issue 1 Section 1.2 (pg 9): "In the preceding summary section, two types of FAP devices are described (i.e. standalone and integrated). Both types of devices are anticipated in the market, and both types of devices are expected to use the TR-098 [3] based device."

The question was raised whether a pure FAP implementation really needs to implement TR-98 as this was seen more gateway related.

In TR-069 Amendment 2 Table 4 (pg 29), the SOAP Header element "ID" is defined as:

"This header element MAY be used to associate SOAP requests and responses using a unique identifier for each request, for which the corresponding response contains the matching identifier. The value of the identifier is an arbitrary string and is set at the discretion of the requester."

Concerns were expressed that "arbitrary string" is a much too vague description and at least the length should be restricted. Further study on the SOAP specification showed that there is no overall length restriction which proved the concerns to be relevant.

In general comments were raised on ambiguous data/parameter descriptions in TR-196 by several plugfest participants. Sometimes one "had to guess" what the other side sends/expects, also caused by the fact that default configurations of the HMS are not necessarily known to the HNB vendors. Resolving the data problems took quite a large part of the testing session so that time was missing for a more complete analysis of the message flows which led to a relative low coverage of the test cases.

# History

| Document history | | |
|---|---|---|
| V1.1.1 | March 2011 | First version |