The 3rd UMTS FemtoCell Plugfest;
Lannion, France;
17-24 June 2011

ETSI

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Contents

1 Executive Summary

The 3rd UMTS FemtoCell Plugfest was held from 17 to 24 June 2011 in Lannion (France).

This event was co-organized by ETSI and the Femto Forum and hosted by Orange. It aimed to test the interoperability of femtocell equipment from all key vendors to verify the 3GPP's Iuh interface. All femtocell equipment was connected to Orange's Integration Network which allowed to conduct the interoperability tests at system integration level.

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.

12 companies participated in this event executing more than 500 interoperability tests.

The companies could not run all foreseen tests, but taken into account that the test plan contained 39 tests (Iuh and security tests), which is a high number of tests per test session, the execution rate of 59% is a satisfying result, especially as it is above the target of 50% execution rate.

94% of the test verdicts were PASS which shows the high level of maturity of the femtocell technology.

2 Introduction

This plugfest aimed to verify the interoperability between femtocell products from different vendors and 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),

The femtocell products were connected with Orange's Integration Network. This Integration Network is a reference environment that is representative for Orange's multi-vendor network, and is used for the purpose of integration testing of new equipment and services.

The test intrastructure provided by Orange allowed for 'CS/PS handout to macro' tests.

Also IPsec/IKEv2 security protocols, that allow femtocells to communicate over the public Internet to system operators' core networks in a highly secure manner, were tested.

All HNBs were provided by vendors at the plugfest premises, in Lannion. But the Gateways (either SeGW or HNB-GW) 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
HNB:	Home Node B
HNB-GW:	Home Node B GateWay
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.

HNB	Company Name	Iuh Rel	Equipment Presence	Staff Presence
	Ablaze Wireless	R9	onsite	onsite
	Alcatel Lucent	R8	onsite	onsite
	Alpha Networks Inc.	R8	onsite	onsite
	Askey Computer Corporation	R8	onsite	onsite
	Continous computing	R9	onsite	onsite
	IP.Access	R8	onsite	onsite
	Node-H GmbH	R8	onsite	onsite
	Picochip	R8	onsite	onsite
SeGW + HNB GW	**Company Name**	**Iuh Rel**	**Equipment Presence**	**Staff Presence**
+ HMS	Alcatel – Lucent	R8	onsite	onsite
no HMS	Cisco	R9	remote	remote
no HMS	NEC Europe Ltd.	R8	remote	onsite
+ HMS	Nokia Siemens Networks	R9	remote	onsite
+ HMS	Huawei	R8	remote	remote

5 Technical and Project Management

All the information presented in this chapter is a extract of the ETSI event wiki
https://services.plugtests.net/wiki/Femtocell3/index.php/Main_Page

5.1 Test Plan

The test plan was provided by Femto Forum IOT SIG. During the regular conference calls which were held as part of the event preparation, companies could propose additional tests. Finally the test plan of the 1st femtocell event was extended with a further 14 tests; which meant a total of 39 tests.

The following table shows the summary of the test objectives, grouped by protocol features.

Group	Test Case ID	Summary

HNB Registration	FIC/HNB/01	HNB registration with HNB-GW
	FIC/HNB/02	HNB Rejection from HNB-GW – Access Control Check
	FIC/HNB/03	HNB Rejection from HNB-GW – Overload Condition
	FIC/HNB/04	HNB-GW Redirection
	FIC/HNB/05	HNB De-Registration – Initiated by HNB
	FIC/HNB/06	HNB De-Registration – Initiated by HNB-GW due to Overload
	FIC/HNB/07	HNB Re-Registration – Loss of IP Connectivity
	FIC/HNB/08	HNB Re-Registration – Short Loss of IP Connectivity
UE Registration	FIC/UET/01	UE Registration with HNB-GW (non-CSG)
	FIC/UET/02	UE Registration Rejection from HNB-GW(non-CSG)
	FIC/UET/03	UE De-Registration with HNB-GW, UE Power Off (non-CSG)
	FIC/UET/04	UE De-Registration with HNB-GW, Periodic Timer Expiry (non-CSG)
	FIC/UET/05	UE De-Registration from HNB-GW (non-CSG)
	FIC/UET/06	UE Re-Registration with HNB-GW (non-CSG)
Iuh Disconnect	FIC/IUH/01	Iu Release
Services	SVC/CSO/01	CS - Mobile Originating (non-CSG)
	SVC/CSO/02	CS - Mobile Terminating (non-CSG)
	SVC/PSO/01	PS - Mobile Originating (non-CSG)
	SVC/CPS/01	CS+PS - Mobile Originating (non-CSG)
	SVC/EMG/01	Emergency Call - Unauthorised UE (non-CSG)
	SVC/EMG/02	Emergency Call - (U)SIM-less UE (non-CSG)
	SVC/EMG/03	Emergency Call - routing with location information
	SVC/EMG/04	Priority Emergency - Emergency call given priority
	SVC/SMS/01	SMS - UE Originating (non-CSG)
Mobility	MOB/CSO/01	CS Handout to Macro Layer
	MOB/CSO/02	Idle Mode UE Mobility - Cell Reselection based on Macro availability
	MOB/CSO/03	PS Handout to Macro Layer
	MOB/CSO/04	Combined CS + PS Handout to Macro Layer

Group	**Test Case ID**	**Summary**
Security	SEC/FSG/01	HNB – 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	IPSec SA Rekeying from HNB
	SEC/FSG/06	IPSec SA Rekeying from SeGW
	SEC/FSG/07	IKE SA Rekeying from HNB
	SEC/FSG/08	IKE SA Rekeying from SeGW
	SEC/FSG/09	Tunnel Deletion
	SEC/FSG/10	HNB Reboot

5.2 Test Scheduling

The preliminary test schedule was developed before the plugfest and was circulated to all the participants in advance for comments. The initial test schedule allowed for each company to test against all present companies which led to an initial proposal of 40 Iuh test sessions and 30 handover test sessions. Every test slot was of a duration of 5 hours. The day was organized in a morning test session from 8.00 to 13.00 and in an afternoon test sessions from 14.00 to 19.00. Up to 5 test sessions in parallel were planned.

During the test event 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.

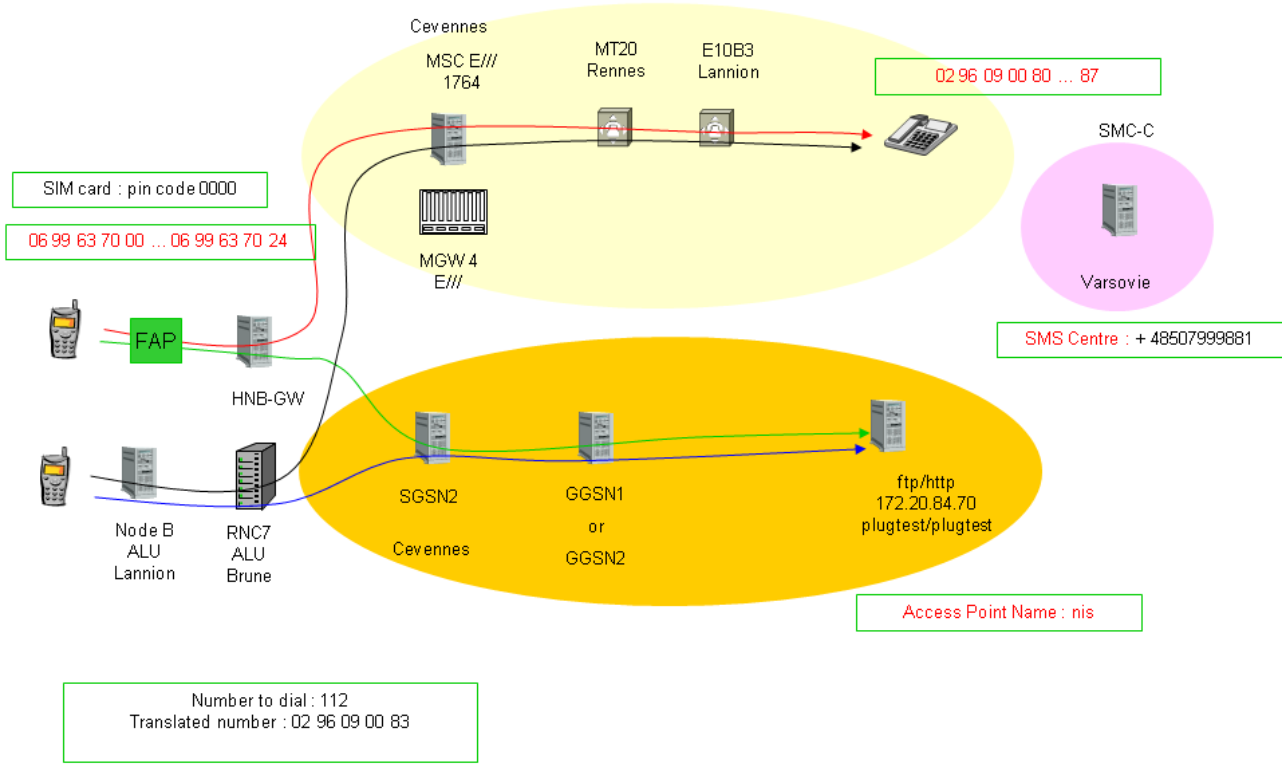
The figure below shows the last version of the test schedule as of Friday 23 June (Please note that test sessions marked with red dotted lines extend over muliple test slots).

		Handover	Iuh 1	Iuh 2	Iuh 3	Iuh 4	Iuh 5
Sat 18	9:00-13:00	Node-H NodeH-HNB Picochip Picochip-HNB NSN NSN-HO	Cisco Cisco-HNB-GW IP.Access IPAccess-HNB	Alpha Networks Alpha-HNB NEC NEC-HNB-GW	Alcatel-Lucent ALU-HNB-GW Askey Askey-HNB	Alcatel-Lucent ALU-HNB Huawei Technologies Huawei-HNB-GW	
	14:00-18:00	IP.Access IPAccess-HNB Node-H NodeH-HNB Picochip Picochip-HNB Cisco Cisco-HO	NSN NSN-HNB-GW Alcatel-Lucent ALU-HNB	Ablaze Ablaze-HNB NEC NEC-HNB-GW	Alcatel-Lucent ALU-HNB-GW Alpha Networks Alpha-HNB	Continuous Computing CCPU-HNB Huawei Technologies Huawei-HNB-GW	
Sun 19	9:00-13:00	Ablaze Ablaze-HNB Alpha Networks Alpha-HNB Alcatel-Lucent ALU-HNB NSN NSN-HO	Picochip Picochip-HNB Huawei Technologies Huawei-HNB-GW	NEC NEC-HNB-GW Continuous Computing CCPU-HNB	Askey Askey-HNB Cisco Cisco-HNB-GW	Alcatel-Lucent ALU-HNB-GW Node-H NodeH-HNB	
Mon 20	9:00-13:00		Node-H NodeH-HNB Huawei Technologies Huawei-HNB-GW	Alpha Networks Alpha-HNB Cisco Cisco-HNB-GW IP.Access IPAccess-HNB	NEC NEC-HNB-GW Alcatel-Lucent ALU-HNB	NSN NSN-HNB-GW Picochip Picochip-HNB	NSN NSN-HNB-GW Continuous Computing CCPU-HNB
	14:00-18:00	Askey Askey-HNB Continuous Computing CCPU-HNB Cisco Cisco-HO	IP.Access IPAccess-HNB Huawei Technologies Huawei-HNB-GW	NEC NEC-HNB-GW Node-H NodeH-HNB	Alpha Networks Alpha-HNB NSN NSN-HNB-GW	Ablaze Ablaze-HNB NEC NEC-HNB-GW	
Tue 21	9:00-13:00	Ablaze Ablaze-HNB Alpha Networks Alpha-HNB NEC NEC-HO	Askey Askey-HNB Huawei Technologies Huawei-HNB-GW	IP.Access IPAccess-HNB NSN NSN-HNB-GW	Alcatel-Lucent ALU-HNB-GW Picochip Picochip-HNB	Cisco Cisco-HNB-GW Continuous Computing CCPU-HNB	
	14:00-18:00	Continuous Computing CCPU-HNB Cisco Cisco-HO	Askey Askey-HNB NEC NEC-HNB-GW	IP.Access IPAccess-HNB NSN NSN-HNB-GW	Ablaze Ablaze-HNB Huawei Technologies Huawei-HNB-GW	NEC NEC-HNB-GW Picochip Picochip-HNB	
Wed 22	9:00-13:00	Picochip Picochip-HNB NSN NSN-HO	IP.Access IPAccess-HNB NEC NEC-HNB-GW	Alpha Networks Alpha-HNB Huawei Technologies Huawei-HNB-GW	Ablaze Ablaze-HNB Cisco Cisco-HNB-GW	Askey Askey-HNB NSN NSN-HNB-GW	
	14:00-18:00	Askey Askey-HNB NSN NSN-HO	Node-H NodeH-HNB NSN NSN-HNB-GW	Cisco Cisco-HNB-GW Picochip Picochip-HNB	NEC NEC-HNB-GW Continuous Computing CCPU-HNB		
Thu 23	9:00-13:00	Ablaze Ablaze-HNB NEC NEC-HO	IP.Access IPAccess-HNB NSN NSN-HNB-GW	Askey Askey-HNB NEC NEC-HNB-GW	Alpha Networks Alpha-HNB NSN NSN-HNB-GW	Cisco Cisco-HNB-GW Picochip Picochip-HNB	Alcatel-Lucent ALU-HNB Huawei Technologies Huawei-HNB-GW
	14:00-18:00	Alpha Networks Alpha-HNB NEC NEC-HO	NEC NEC-HNB-GW Alcatel-Lucent ALU-HNB	NSN NSN-HNB-GW Continuous Computing CCPU-HNB	NEC NEC-HNB-GW Picochip Picochip-HNB	Askey Askey-HNB Cisco Cisco-HNB-GW	Cisco Cisco-HNB-GW Node-H NodeH-HNB
Fri 24	9:00-13:00	IP.Access IPAccess-HNB Cisco Cisco-HO	Ablaze Ablaze-HNB NSN NSN-HNB-GW	Alpha Networks Alpha-HNB NEC NEC-HNB-GW	Askey Askey-HNB Huawei Technologies Huawei-HNB-GW		

5.3 Test Infrastructure

Orange's Network Integration Centre for Service Deployment (NIS) provided access to their infrastructure. It especially contained:

- SMS server
- Handover station
- Ftp/HTTP server
- UMTS Core network R7
- Sigtran configurwstion in IPSP mode

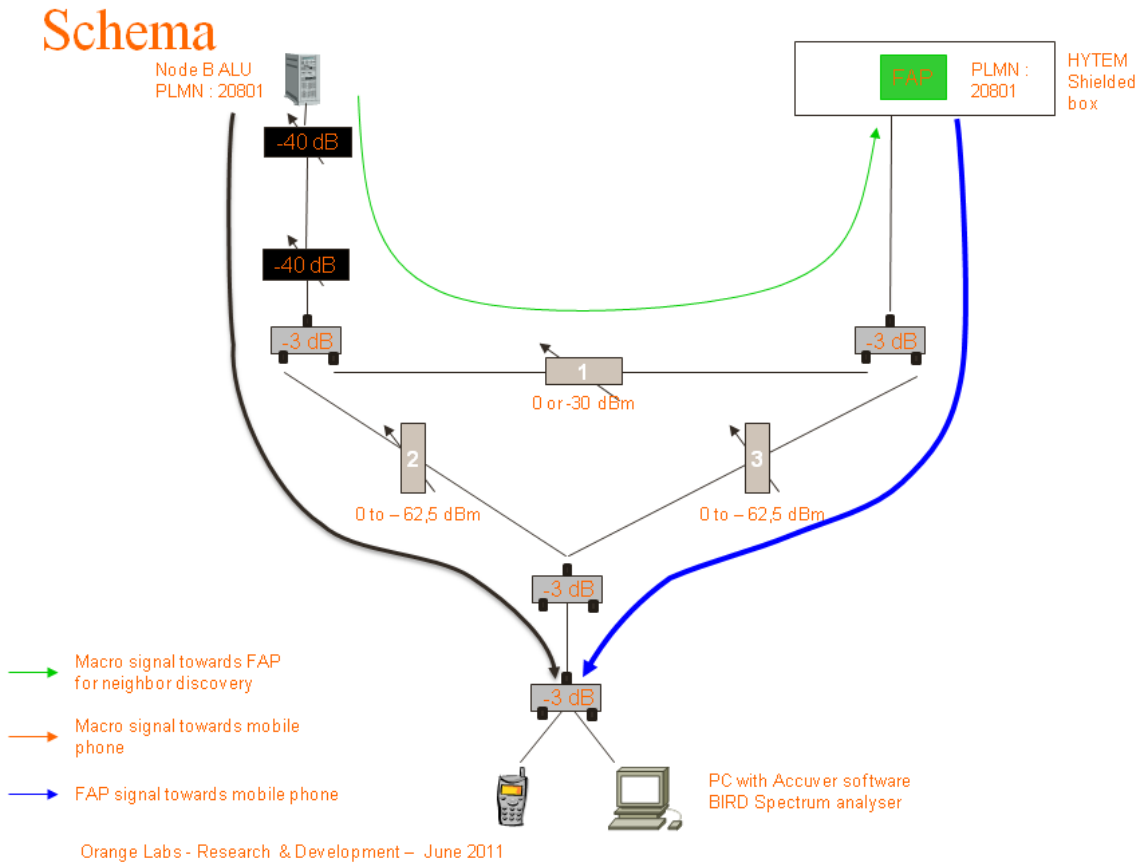


5.4 Handover Station

The handover station was realized as depicted below. No issues with the test setup were experienced. Any issues related to handover tests were protocol stack related. 2 staff members from Orange assisted the HNB teams through the tests as described below. Intra and inter frequency tests were conducted.

- Step 1 : start FAP and wait for neighbouring detection
    - Attenuator 1 in 0 dB position.
    - When the macro cell is in the neighbouring list of the FAP, then put attenuator 1 to 30 dB position in order to minimise macro's signal in the shielded box

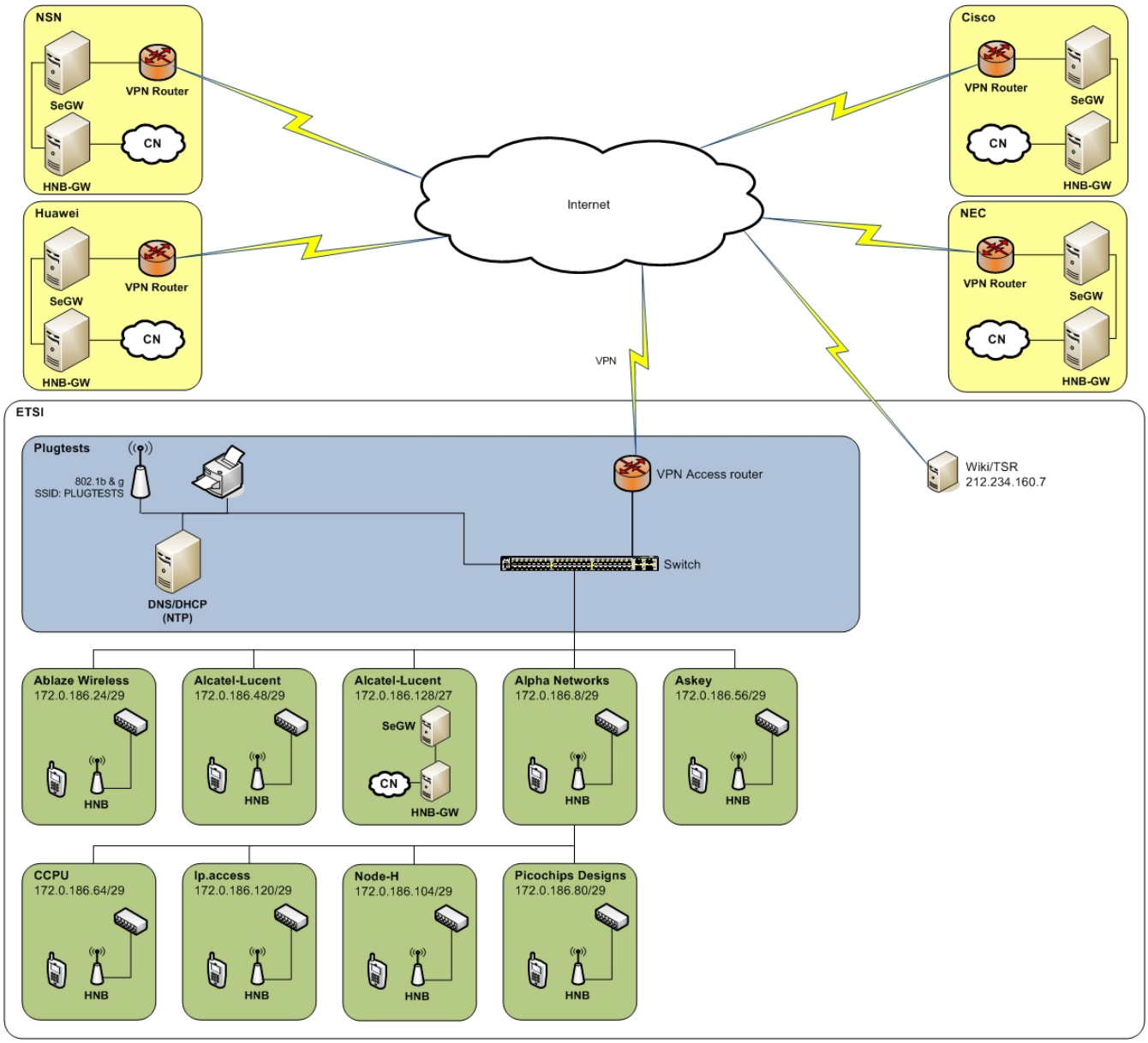
- Step 2 : attachment of UE to the FAP
    - The attenuator 3 is on 0 dB position.
    - Put the attenuator 2 on 62,5 dB position, and wait for the attachment of the UE to the FAP
- Step 3 : handover from FAP to macro
    - Put the attenuator 2 on 0 dB position
    - Increase the attenuator 3 from 0 to x dB position until handover is done



5.5 Local and remote connections to the Integration Network

- The HNBGW providers participating in the plugfest used equipment remotely located in their premises and needed reliable connections to the equipment on site in the plugfest venue.
- For the purpose of privacy it was required to provide separate independent IP subnets to each HNB.

The following figure shows the local and remote connections, which was deployed during the plugfest.



5.6 Security Certificates

HNB digital certificate based authentication was applied (EAP-AKA with certificate was not applied). ETSI provided the service to create and support the certificate creation process. Companies could choose between the following options:

1. ETSI root CA
1.1 ETSI generates a private key and a public certificate for your device
1.2 You generate a private key and send a certificate signing request to Plugtests@etsi.org
2. Your own root CA
2.1 You send your Root CA Public Key and the certificate of your device to Plugtests@etsi.org

6 Achieved Results

All vendors were initially invited to attend a 1 day pre-testing session on 17 June; finally the pretesting session was extended to 18 and 19 June (AM only) . The goal was to get all equipement ready 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 femtocell features prior to the execution of the interoperability test sessions. The correct setup of the IPsec tunnels was experienced as a challenge for most of the vendors. For a next event it is recommend to provide well in advance of the plugfest date a permanent IPSec endpoint accessible via public internet so that participants can validate their IPSec settings before the event.

Highlights of the test sessions were that

- 2 FAP vendors succeeded with a PS handout test
- 1 FAP vendor succeeded with both, CA and PS handout tests

6.1 Iuh Result Overview

The test plan of the 1st femtocell plugfest was extended with a further 14 tests; which meant a total of 29 tests. The table and figure below show the results. The companies could not run all foreseen tests, but taken into account that the test plan contained 29 tests, which is a high number of tests per test session, the execution rate of 60% is a satisfying result, especially as it is above the target of 50% execution rate.

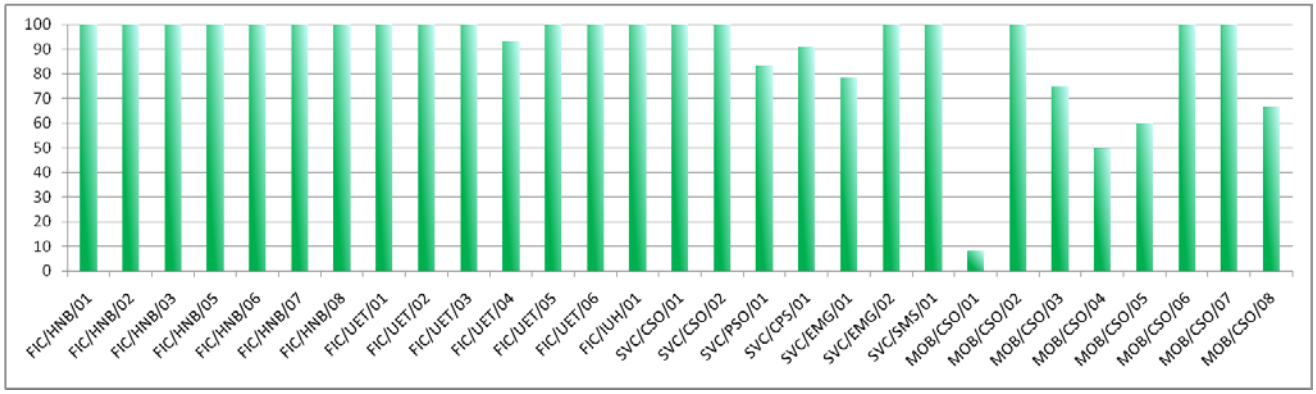
94% of the test verdicts were PASS which shows the high level of maturity of the FemtoCell technology.

Interoperability Result		Execution Statistic		
OK	not OK	Not Applicable	Out of Time	Run
421 (93.6%)	**29 (6.4%)**	**95 (12.7%)**	**205 (27.3%)**	**450 (60.0%)**

6.2 Results per Iuh test

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

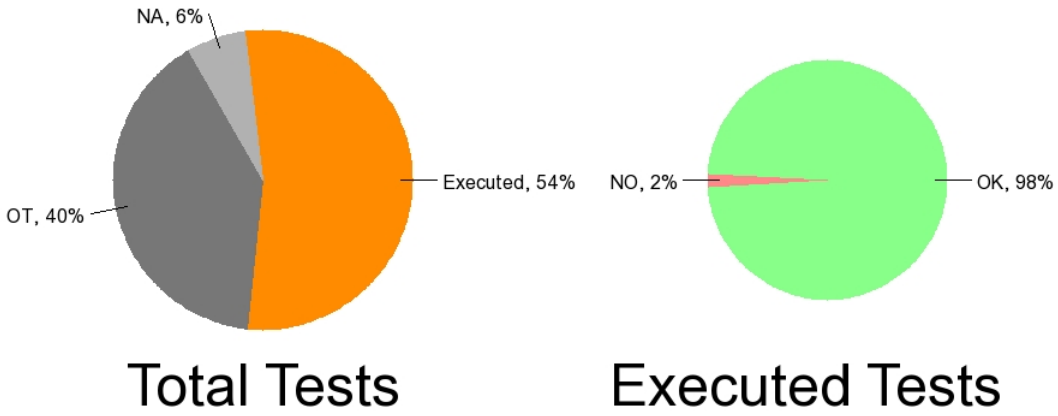
The mobility tests were in the focus of this plugfest and this was the group of tests which encountered the most interoperability issues. The tests took longer than expected. The initial schedule was modified to provide every HNB a test slot of 5 hour duration. This meant that all HNBs could only have 1 test slot which showed not to be enough test slots. For a next event it is recommended to make more handover test slots available. More debug information from the MSC and RNC logs would have helped to support the testing better. On the other hand it must be stated that the mobility tests are complex and that a plugfest is probably not the appropriate place to achieve great progress if companies come to test without having trieed out first mobility tests beforehand. An other outcome was that the physical realization of the handover station worked well.



6.3 IPSec Result Overview

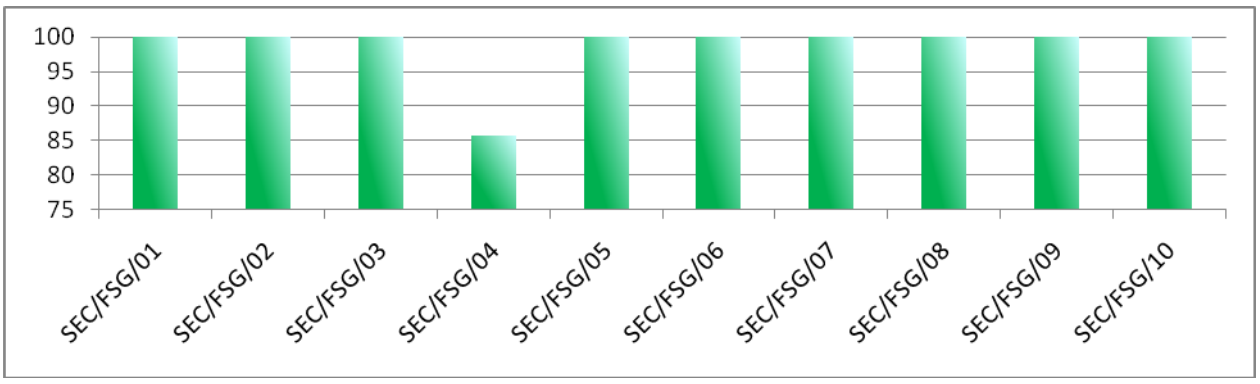
The test plan of the 1st femtocell plugfest was extended with a further 3 tests; which meant a total of 10 tests.The table and figure below show the results. The tests that were considered an essential pre-requisite for the Iuh interoperability. The high number of interoperability results and the fact that security tests have been execute in plugfest 1 and 3 allows to draw the conclusion that for a next event the security tests should be made optional so that more time can be dedicated to other tests.

Interoperability Result		Execution Statistic		
OK	not OK	Not Applicable	Out of Time	Run
58 (98.3%)	**1 (1.7%)**	**7 (6.4%)**	**44 (40.0%)**	**59 (53.6%)**



6.4 Results per IPSec test

The figure below lists all tests, and shows the OK percentage of all submitted tests. There was only one interop issues encountered with SEC/FSG/04 with the IPsec tunnel re-establishment.



6.5 Summary of Wrap Up Sessions

6.5.1 IOP Issues

- The IPSec tunnel establishment between HNB and HNBGW was a challenge and consumed a lot of time. Considering that ~ 40 tests had to be executed in 5 hours, it is not manageable to dedicated half of the test session time to IPsec tunnel establishment.
    - For a next event it is recommend to provide well in advance of the plugfest date a permanent IPSec endpoint accessible via public internet so that participants can validate their IPSec settings.
- IPv4 Address Encoding in an NSAPA
    - In some cases where an IPv4 address was embedded inside a 20-octet NSAP address, the padding bytes where not present.
- Handover testing took longer than expected. The initial schedule was modified to provide evry HNB a test slot of 5 hour duration. This meant that all HNBs could only have 1 test slot which showed not to be enough test slots.
    - The physical realization of the handover station worked well
    - For a next event it is recommended to make more handover test slots available
    - For a next event it is recommended to provide more debugging support on MSC and RNC side
- It was experienced that the HNBGW remote support teams were not very reactive during the week end.
    - For a next event it is recommended that a plugfest starts on a Monday rather than on a Friday, in order to have the remote support teams available in the initial phase of the plugfest.
- The PASS rate of the Security tests is very high. Security tests have been execute in plugfest 1 and 3.
    - For a next event it is recommended to make the tests optinal so that more time can be dedicated to other tests.

6.5.2 Base Spec Issues

- Timing when UE De-registration is triggered by HNB-GW and HNB
    - Not addressing this issue creates problem in applications using UE presence information and debugging the femto network when equipment from different manufacturers is deployed.
- Re-direction: When given 3 SeGWs and 3HNB-GWs FQDNs, in which order, and with which back-off timers is re-direction triggered?
    - Not addressing this issue creates problem in designing redundancy and recovery schemes when different vendor equipments is used.

6.5.3 Test Spec Issues

- The test specification FF_WG3_Fa_Interop(08)_v1.3.doc was provided as input to the event. Based on the discussion during the wrap up meetings 2 consecutive versions were produced with FF_WG3_Fa_Interop(08)_v1.5.doc being the latest version.
- The following tests were excluded from the test plan
    - SEC/FSG/11 WAN side IP address change
    - FIC/HNB/04 HNB-GW Redirection
    - FIC/HNB/09 HNB Re-registration - Long duration WAN failure
    - SVC/EMG/03 Emergency Call - routing with location information
    - SVC/EMG/04 Priority Emergency - Emergency call given priority

- The following tests were made optional
    - FIC/HNB/03 HNB Rejection from HNB GW – Overload Condition
    - FIC/HNB/06 HNB De-Registration – Initiated by HNB-GW due to Overload
    - FIC/UET/05 UE De-Registration from HNB-GW
- The 4 mobility tests were modified to take into account the possibility to run them in intra or inter frequency mode. For the matter of reporting the results with the ETSI Test Reporting Tool, it was decided to run create 8 tests: MOB/CSO/01 – 04 were to be run in intra frequency mode and MOB/CSO/05 – 06 in interfrequency mode.

History

Document history		
V1.1.1	June 2011	First version