

Home Gateway Initiative

Test Task Force

2009 Test case Specification

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Abstract

This document is the HGI Test Specification that was used for the 2009 test event, held in Lannion, France in September, 2009. Note that a different test plan for the 2010 test event is under development within HGI. The 2010 test plan is based upon the 2009 test plan but updates some test cases and extends the scope of testing.

Table of Contents

Table of Contents	2
1 Important notice, IPR statement, disclaimer and copyright	5
2 Scope	5
3 Technical architecture and rationale	6
4 Terminology.....	6
5 Unitary tests	7
5.1 Objectives.....	7
5.2 Tests configuration	7
5.2.1 Unitary WAN Ethernet tests	8
5.2.1.1 Test setup	9
5.2.1.2 Test configuration	9
5.2.2 Unitary LAN Ethernet test	10
5.2.2.1 Test setup	10
5.2.2.2 Test configuration	10
5.2.3 Unitary LAN Ethernet, LAN Wi-Fi test	11
5.2.3.1 Test setup	11
5.2.3.2 Test configuration	12
5.2.4 Unitary WAN Ethernet, LAN Wi-Fi tests.....	13
5.2.4.1 Test setup	14
5.2.4.2 Test configuration	14
5.2.5 Unitary ADSL tests.....	15
5.2.5.1 Test setup	16
5.2.5.2 Test configuration	16
5.2.6 Unitary USB tests WAN-LAN.....	19
5.2.6.1 Test setup	19
5.2.6.2 Test configuration	19
5.2.7 Unitary USB tests LAN-LAN.....	20
5.2.7.1 Test setup	21
5.2.7.2 Test configuration	21
6 QoS test specification.....	23
6.1 Traffics description synthesis.....	23
6.2 Egress LAN Ethernet interface.....	25
6.2.1 Test objective	25
6.2.2 Queue configuration on Ethernet interface.....	25
6.2.3 Test Setup.....	26
6.2.4 Classification sequence description	26
6.2.5 Tests description	26
6.2.5.1 VoIP traffic	26
6.2.5.2 AV traffic.....	26
6.2.5.3 Internet traffic	26 27
6.2.5.4 LAN to LAN traffic.....	27
6.2.5.5 Multiservices tests	27
6.3 Egress LAN Wi-Fi interface.....	28
6.3.1 Test objective	28
6.3.2 Queue configuration on Wi-Fi interface.....	28
6.3.3 Test Setup.....	28 29
6.3.4 Classification sequence description	29
6.3.5 Test description	29
6.3.5.1 VoIP traffic	29
6.3.5.2 AV traffic.....	29
6.3.5.3 Internet traffic	29 30
6.3.5.4 LAN to LAN traffic.....	30
6.3.5.5 Multiservices tests	30
6.4 USB attached storage	30 31
6.4.1 Test objective	31
6.4.2 Test description	31
6.4.3 Queue configuration on Ethernet interface.....	31
6.4.4 Test setup	32

6.5	Egress WAN test configuration / ADSL	3233
6.5.1	Test objective	3233
6.5.2	Queue configuration on WAN interface	33
6.5.3	Test setup	33
6.5.4	Test description	34
6.5.4.1	VoIP	34
6.5.4.2	AV	34
6.5.4.3	Premium data	34
6.5.4.4	Data	34
6.5.4.5	Multi-services	34
7	Multiple session test cases / Ethernet test setup	35
7.1	Rationale	35
7.2	Test setup	35
7.3	Test description	35
8	Energy savings tests	36
9	Correlation between tests and HGI requirements	36
10	References	36
11	Annex	38
11.1	E model and R factor values	38
11.2	Results sheet example	38
11.3	Power equipment specifications	38
11.3.1	Power source: Chroma 6530	39
11.3.2	Power meter probe: 80i-110s AC/DC current clamp	39

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2 Scope

This document describes the architecture and configuration for a number of test cases which are made available to participants of the HGI test event.

The objectives of the test event are

- To enable manufacturers of home gateways and home gateway chipsets to evaluate the performance of their solutions against a set of test cases which reflect HGI service provider requirements. The audited results of the test event, in which test cases from this test plan are executed and audited by the HGI, are owned by the participant and may be used for internal evaluation, marketing, or any other purpose.
- To enable service providers to pre-qualify home gateway solutions against commonly agreed test requirements, by engaging in discussion with test event participants.
- To enable HGI to gain an overall understanding of the current performance of home gateway solutions

- specific configurations and under specific conditions. This will enable HGI to assess the level of support of the HGI specifications within the industry. As such the information is only relevant if sufficient vendors participate to the event.

An additional purpose of the test plan is:

- To enable the HGI test cases to be implemented in other test labs so that a testing service becomes available to the industry reflecting the commonly agreed requirements of the HGI service providers.

The testing event conditions and the testing process are described in [1].

Participation in the test event is submitted to the approval of the NDA (see [4])

3 Technical architecture and rationale

The overall home gateway architecture is based on the routed model with L2 partial bridge as described section 7.6 of [8]:

- LAN to WAN and WAN to LAN traffic are routed
- PPPoE passthrough is allowed
- LAN to LAN traffics are bridged

WAN connectivity is based on IPoE, and has been selected mainly for simplicity reasons compared to PPP. Nevertheless this choice is relevant because it corresponds to field applications like walled garden VoIP and TV applications and for some telcos IPoE is also used for internet access.

All traffic (VoIP, AV, Premium data, Data, Internet) is emulated to assure repeatability of the tests and avoid services interoperability issues, for example VoIP signalling stack.

4 Terminology

Device under test (DUT): The device which is tested. This can either be a Home Gateway or a reference design.

Throughput [3]: The maximum rate at which none of the offered frames are dropped by the device

Latency [3]: The time interval starting when the last bit of the input frame reaches the input port and ending when the first bit of the output frame is seen on the output port.

Test [2]: A particular test consists of multiple trials. Each trial returns one piece of information, for example the loss rate at a particular input frame rate. Each trial consists of a number of phases:

a) If the DUT is a router, it sends the routing update to the "input" port and pauses two seconds to be sure that the routing has settled.

b) Send the "learning frames" to the "output" port and wait 2 seconds to be sure that the learning has settled. Bridge learning frames are frames with source addresses that are the same as the destination addresses used by the test frames. Learning frames for other protocols are used to prime the address resolution tables in the DUT. The formats of the learning frame that should be used are shown in the Test Frame Formats document.

c) Run the test trial.

d) Wait for two seconds for any residual frames to be received.

e) Wait for at least five seconds for the DUT to restabilize.

Test setup: The test architecture and configuration parameters used when performing a test

Dichotomous method: consists of several steps:

- define the interval (lower and upper limit) in which the result is supposed to lie
- define the test precision
- the test can be started at the lower or upper limit (the upper limit is preferred)
- several iterations are performed to search the results by dividing the interval into two different and non overlapping segments.

LAN Bridge: as specified in IEEE 802.1D

5 Unitary tests

5.1 Objectives

The objective of these tests is to measure throughput and latency for different WAN and LAN configurations. Throughput is given in frames per second (fps) and latency will be measured at the throughput rate in μ s. These two parameters will be measured as a function of the frame size

Unitary tests are based on RT bench, RFC[2544] measuring throughput and latency in the upstream or downstream direction only. Combination of upstream and downstream flows simultaneously is not considered. RTBench generates IP packets of various sizes, and reports throughput at the maximum lossless level--the highest point at which 100 percent of submitted packets are received. Latency calculations were also made at the maximum lossless throughput level.

4 values of frame sizes are tested: 66, 512, 1024, 1518 bytes.

5.2 Test configuration

For each RT bench test and each frame size, trial duration is 1 minute as recommended in [2]. Since the time is limited (only one day per vendor) we have configured the different parameters (especially: lower limit, upper limit, and precision) of each RT bench test so that for each frame size there are no more than 4 iterations.

The configuration of the network tester is done as percentage of bitrate of the network tester's Ethernet interface. This bitrate is described in the following table:

frame size	Theoretical Ethernet Throughput		
	Mbps	Percentage	frame per sec
66	76,74	100%	145340
512	96,24	100%	23496
1024	98,08	100%	11973
1518	98,69	100%	8127

Table 1: mapping between Ethernet percentage and bitrate for 100Mbps

For this entire unitary test we are using the following stack and ports:

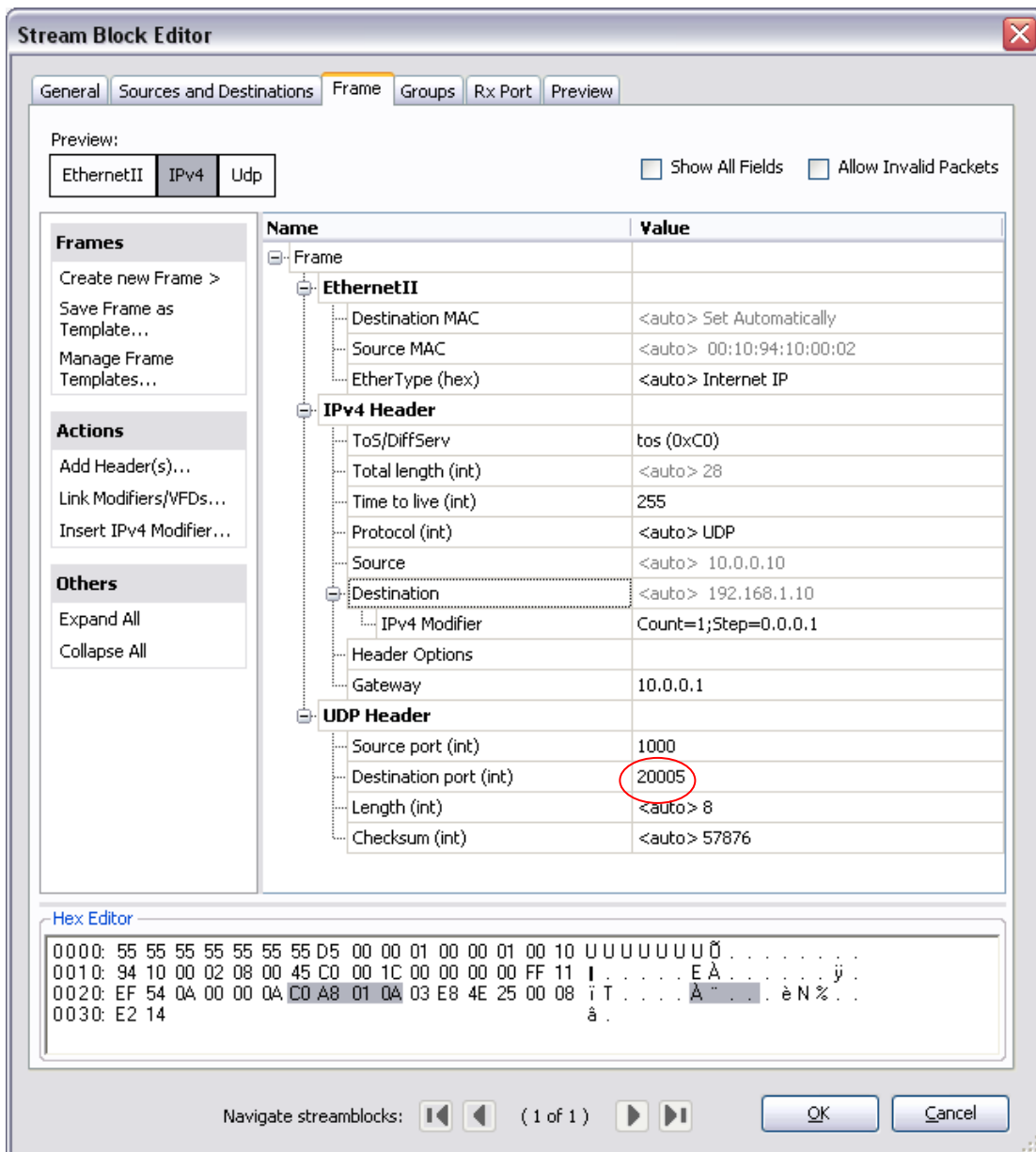


Figure 1: Spirent Test Center configuration window ("stream block editor")

So, for every WAN to LAN test a redirection rule to LAN IP address (192.168.1.10) has to be implemented, but is left open to the implementer:

- This redirect rule could be based on the WAN IP source @ (10.0.0.10)
- Or could be based on the UDP destination port (20005)
- Or both

5.2.1 Unitary WAN Ethernet tests

In the **Ethernet configuration**, test set up will be calibrated in a back to back configuration without the devices under test in order to retrieve the network contribution to the different results.

Test #1: WAN Ethernet to LAN Ethernet – routed mode – NAT function activated – Firewall function deactivated

Test #2: LAN Ethernet to WAN Ethernet – routed mode - NAT function activated – Firewall function deactivated

5.2.1.1 Test setup

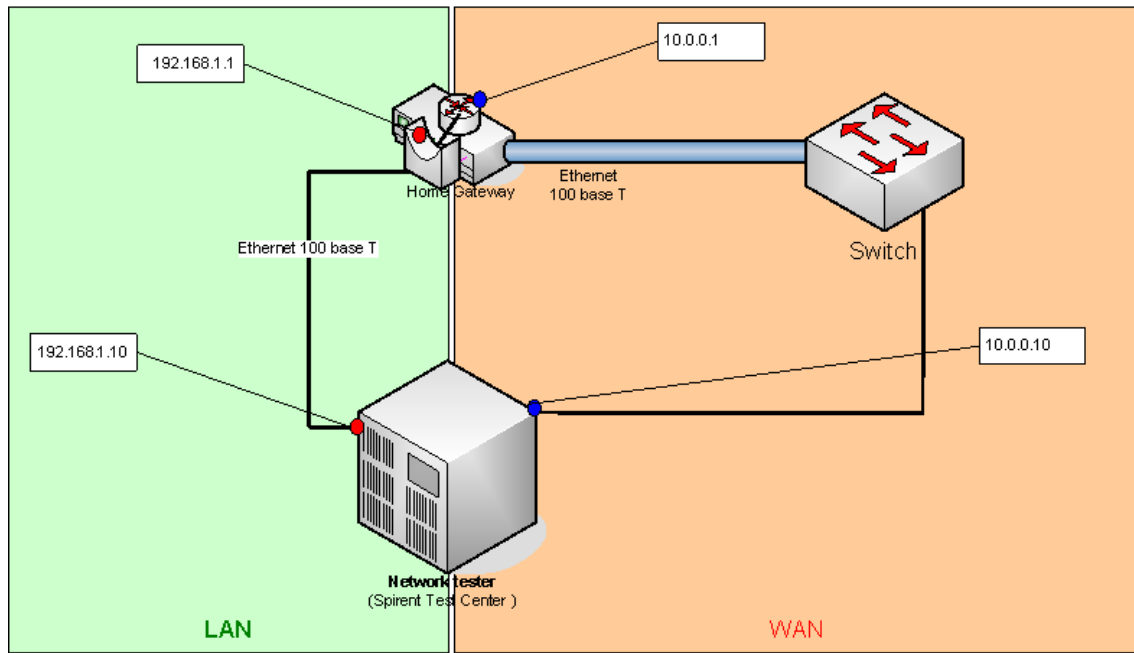


Figure 2: tests #1 & #2 setup

5.2.1.2 Test configuration

Home Gateway configuration

- access interface
 - o 100 base T full duplex mode, auto negotiation
 - o IP/Eth
 - o Single fixed IP address (10.0.0.1 /255.255.255.0)
 - o Routed forwarding mode
 - o NAPT function activated
 - o Firewall deactivated
- LAN interface
 - o Eth0 100 base T full duplex mode, auto-negotiation
 - o Single fixed LAN IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC (Spirent Test Center) interfaces speed is configured in 100 Mbps full duplex mode, auto negotiation or fixed.

Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]	Results
1 & 2	66	lower limit	98.8 % ⇔ [75,82 Mbps]
		upper limit	100 % ⇔ [76,74 Mbps]
		initial rate	100 % ⇔ [76,74 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	98.8 % ⇔ [95,08 Mbps]
		upper limit	100 % ⇔ [96,24 Mbps]
		initial rate	100 % ⇔ [96,24 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
1024	lower limit	98.8 % ⇔ [96,91 Mbps]	[FAILED]* or [PASS with fps & latency]

Home Gateway Initiative

		upper limit	100 % ⇔ [98,08 Mbps]	fps & latency]
		initial rate	100 % ⇔ [98,08 Mbps]	
		precision	0.5%	
		acc. frame loss	0.1%	
	1518	lower limit	98.8 % ⇔ [97,51 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [98,69 Mbps]	
		precision	100 % ⇔ [98,69 Mbps]	
		initial rate	0.5%	
	acc. frame loss	0.1%		

(*): a test "Failed" does not mean that the throughput is 0 but the value of the throughput can not be computed in the range [lower limit; Upper limit]. This range is configured near the theoretical throughput with a high precision to obtain a relevant result.

5.2.2 Unitary LAN Ethernet test

Test #3: LAN Ethernet to LAN Ethernet – bridge mode

5.2.2.1 Test setup

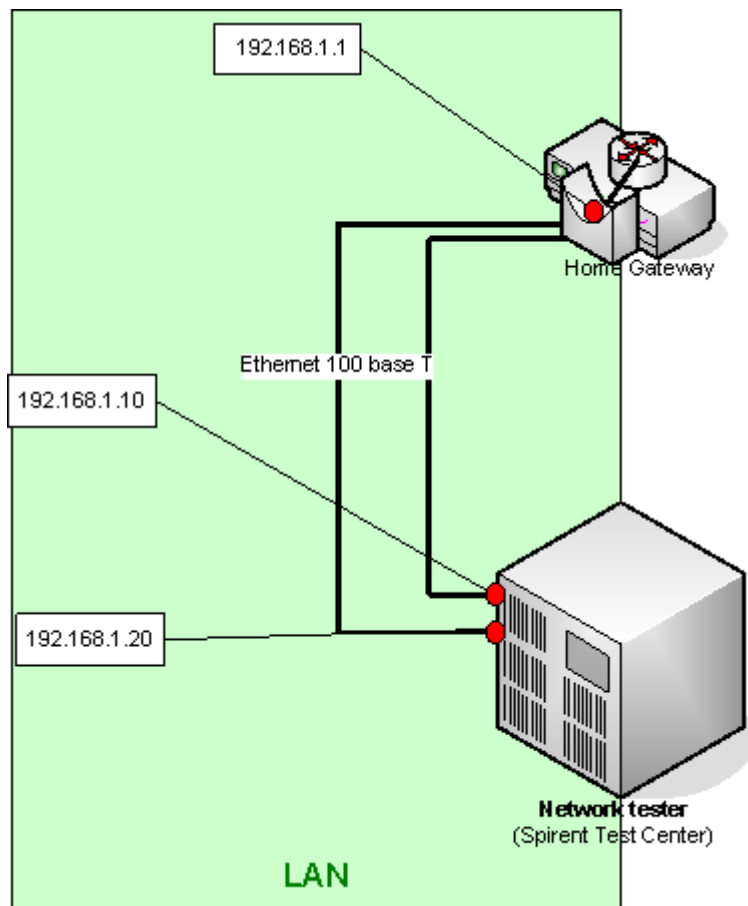


Figure 3: test #3 setup

5.2.2.2 Test configuration

Home Gateway configuration

- access interface
 - o NA
- LAN interface
 - o Eth0 + Eth1 – 100 base T full duplex mode, auto-negotiation
 - o LAN bridge mode (Eth0 + Eth1)
 - o Single fixed LAN IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode.
 Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]	results
3	66	lower limit	98.8 % ⇔ [75,82 Mbps]
		upper limit	100 % ⇔ [76,74 Mbps]
		initial rate	100 % ⇔ [76,74 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	98.8 % ⇔ [95,08 Mbps]
		upper limit	100 % ⇔ [96,24 Mbps]
		initial rate	100 % ⇔ [96,24 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	1024	lower limit	98.8 % ⇔ [96,91 Mbps]
		upper limit	100 % ⇔ [98,08 Mbps]
		initial rate	100 % ⇔ [98,08 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	1518	lower limit	98.8 % ⇔ [97,51 Mbps]
		upper limit	100 % ⇔ [98,69 Mbps]
		initial rate	100 % ⇔ [98,69 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
			[FAILED]* or [PASS with fps & latency]
			[FAILED]* or [PASS with fps & latency]
			[FAILED]* or [PASS with fps & latency]
			[FAILED]* or [PASS with fps & latency]

(*): a test "Failed" does not mean that the throughput is 0 but the value of the throughput can not be computed in the range [lower limit; Upper limit]. This range is configured near the theoretical throughput with a high precision to obtain a relevant result.

5.2.3 Unitary LAN Ethernet, LAN Wi-Fi test

Test configurations that include **Wi-Fi equipment**, Wi-Fi version is 802.11g with WPA2 security activated value of "HOMEGATEWAYINITIATIVETESTEVENT" and an SSID value of:

- "HGITESTEVENT1" or
- "HGITESTEVENT2" or
- "PREHGITESTEVENT"

Only one of these SSID values will be provided according to the workplace on which test will be performed (3 different workplaces collocated). WiFi channels will be indicated according to the environment to minimise interference.

Access point is configured as such that the 54 Mbps Wi-Fi profile is forced.

Test #4: LAN Ethernet to Wi-Fi Station – bridge mode
Test #5: Wi-Fi station to LAN Ethernet – bridge mode

5.2.3.1 Test setup

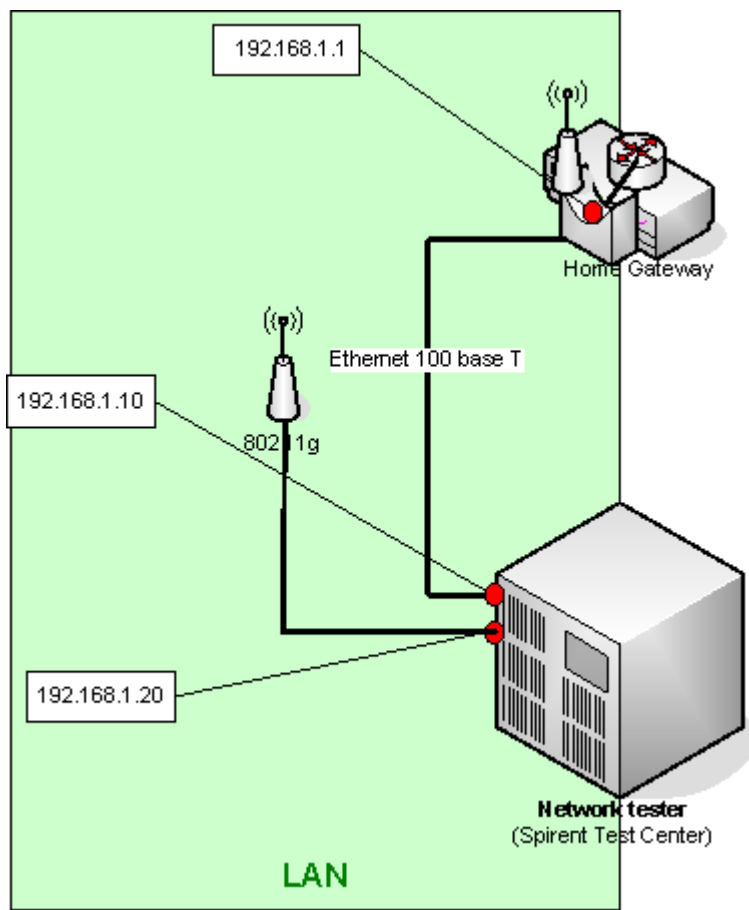


Figure 4: test #4 & #5 setup

5.2.3.2 Test configuration

Home Gateway configuration

- access interface
 - o NA
- LAN interface
 - o Wi-Fi IEEE802.11 g WMM compliant with WPA2 = HOMEGATEWAYINITIATIVETESTEVEN and SSID = HGITESTEVEN1 or HGITESTEVEN2 or PREHGITESTEVEN
 - o Eth0- 100 base T full duplex mode, auto-negotiation
 - o LAN bridge mode (Wi-Fi0 + Eth0)
 - o Single fixed LAN IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode. Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]	results
4	66	lower limit	1.1 % ⇔ [0,84 Mbps]
		upper limit	2.3 % ⇔ [1,77Mbps]
		initial rate	2.3 % ⇔ [1,77 Mbps]
		Precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	10 % ⇔ [9,62 Mbps]
upper limit	11.2 % ⇔ [10,78 Mbps]		
initial rate	11.2 % ⇔ [10,78 Mbps]		

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		Precision	0.5%	[FAILED]* or [PASS with fps & latency]
		acc. frame loss	0.1%	
	1024	lower limit	16.2 % ⇔ [15,89 Mbps]	
		upper limit	17.4 % ⇔ [17,07 Mbps]	
		initial rate	17.4 % ⇔ [17,07 Mbps]	
		Precision	0.5%	
		acc. frame loss	0.1%	
	1518	lower limit	19.8 % ⇔ [19,54 Mbps]	
		upper limit	21 % ⇔ [10,73 Mbps]	
		initial rate	21 % ⇔ [10,73 Mbps]	
		Precision	0.5%	
		acc. frame loss	0.1%	

test #	frame size	test conf in % and [corresponding Eth birate]	results
5	66	lower limit	3 % ⇔ [2,30 Mbps]
		upper limit	4.2 % ⇔ [3,22 Mbps]
		initial rate	4.2 % ⇔ [3,22 Mbps]
		Precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	15.8 % ⇔ [15,21 Mbps]
		upper limit	17 % ⇔ [16,36 Mbps]
		initial rate	17 % ⇔ [16,36 Mbps]
		Precision	0.5%
		acc. frame loss	0.1%
	1024	lower limit	21.1 % ⇔ [20,70 Mbps]
		upper limit	22.3 % ⇔ [21,87 Mbps]
		initial rate	22.3 % ⇔ [21,87 Mbps]
		Precision	0.5%
		acc. frame loss	0.1%
	1518	lower limit	28.2 % ⇔ [27,83 Mbps]
		upper limit	29.4 % ⇔ [29,02 Mbps]
		initial rate	29.4 % ⇔ [29,02 Mbps]
		Precision	0.5%
		acc. frame loss	0.1%

5.2.4 Unitary WAN Ethernet, LAN Wi-Fi tests

Test configurations that include **Wi-Fi equipment**, Wi-Fi version is 802.11g with WPA2 security activated value of "HOMEGATEWAYINITIATIVETESTEVEN" and a single SSID value of "HGITESTEVEN"

Access point is configured as such that the 54 Mbps Wi-Fi profile is forced.

Test #6: Wi-Fi station to WAN Ethernet – routed mode NAT function activated – Firewall function deactivated

Test #7: WAN Ethernet to Wi-Fi station – routed mode NAT function activated – Firewall function deactivated

5.2.4.1 Test setup

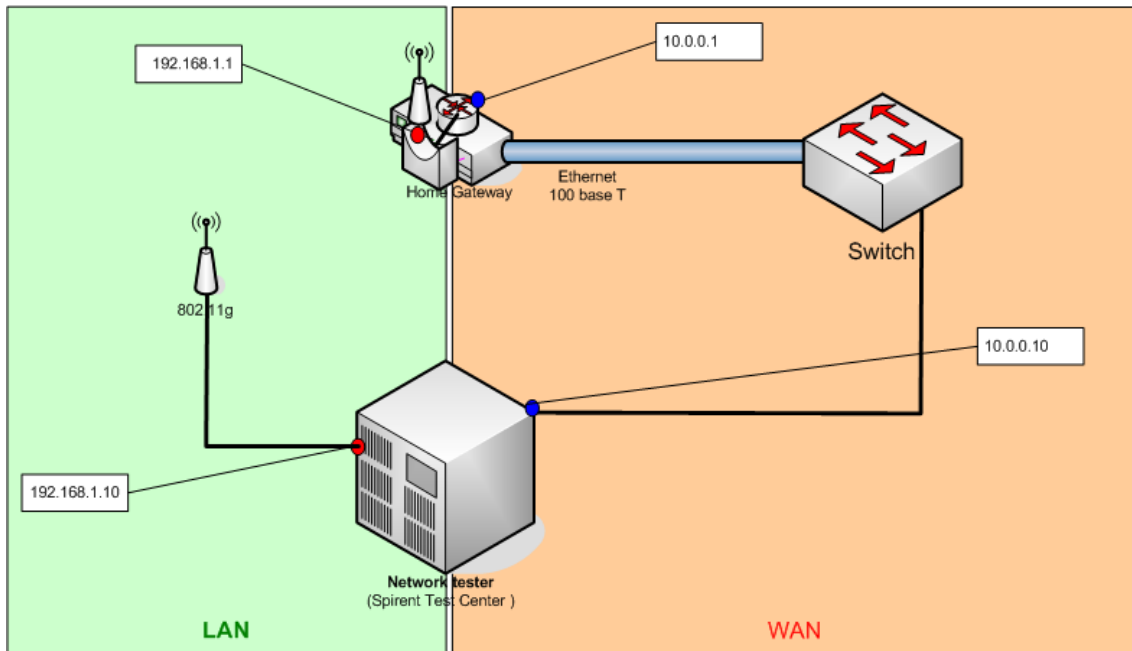


Figure 5: tests #6 & #7 setup

5.2.4.2 Test configuration

Home Gateway configuration

- access interface
 - o 100 base T full duplex auto negotiation
 - o IP/Eth
 - o Single fixed IP address (10.0.0.1 /255.255.255.0)
 - o Routed forwarding mode
 - o NAPT function activated
 - o Firewall deactivated
- LAN interface
 - o Wi-Fi IEEE802.11 g WMM compliant and WPA2 = HOMEGATEWAYINITIATIVETESTEVENT and SSID = HGITESTEVENT1 or HGITESTEVENT2 or PREHGITESTEVENT
 - o Single fixed LAN IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode. Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]	results
6	66	lower limit	3.2% ⇔ [2,46 Mbps]
		upper limit	4.4 % ⇔ [3,38 Mbps]
		initial rate	4.4 % ⇔ [3,38 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	20.8 % ⇔ [20,02 Mbps]
		upper limit	22 % ⇔ [21,17 Mbps]
		initial rate	22 % ⇔ [21,17 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
			[FAILED]* or [PASS with fps & latency]
			[FAILED]* or [PASS with fps & latency]

Home Gateway Initiative

	1024	lower limit	25 % ⇔ [24,52 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	26.2 % ⇔ [25,70 Mbps]	
		initial rate	26.2 % ⇔ [25,70 Mbps]	
		precision	0.5%	
		acc. frame loss	0.1%	
	1518	lower limit	25 % ⇔ [24,67 Mbps]	
		upper limit	26.2 % ⇔ [25,86 Mbps]	
		initial rate	26.2 % ⇔ [25,86 Mbps]	
		precision	0.5%	
		acc. frame loss	0.1%	

test #	frame size	test conf in % and [corresponding Eth birate]	results		
7	66	lower limit	1.2% ⇔ [0,92 Mbps]	[FAILED]* or [PASS with fps & latency]	
		upper limit	2.4 % ⇔ [1,84 Mbps]		
		initial rate	2.4 % ⇔ [1,84 Mbps]		
		precision	0.5%		
		acc. frame loss	0.1%		
	512	lower limit	10.6 % ⇔ [10,20 Mbps]		
		upper limit	11.8 % ⇔ [11,36 Mbps]		
		initial rate	11.8 % ⇔ [11,36 Mbps]		
		precision	0.5%		
		acc. frame loss	0.1%		
	1024	lower limit	16.1 % ⇔ [15,79 Mbps]		[FAILED]* or [PASS with fps & latency]
		upper limit	17.3 % ⇔ [16,97 Mbps]		
		initial rate	17.3 % ⇔ [16,97 Mbps]		
		precision	0.5%		
		acc. frame loss	0.1%		
	1518	lower limit	20.6 % ⇔ [20,33 Mbps]		
		upper limit	21.8 % ⇔ [21,52 Mbps]		
		initial rate	21.8 % ⇔ [21,52 Mbps]		
		precision	0.5%		
		acc. frame loss	0.1%		

5.2.5 Unitary ADSL tests

DSL calibration is going to be realised with a reference DSL modem in bridge mode configured with the two ADSL profiles #1 and #2 (described below).

Note the intention is not to test ADSL PHY, but to test the implementation of the queuing and ATM SAR interface which is used in ADSL. While the tests in most other sections of the Test Specification use Ethernet interfaces, which can offer much higher traffic levels, the tests in this section will provide a check that the throughput and latency for the ADSL interface are within expected limits. These are the only tests which specifically assess the ATM queue/SAR implementations. The results provide a line base as a reference for all ADSL tests (section 5.5) with the home gateway.”

Test #8: LAN to WAN with ADSL profile # 1 without any prioritization– routed mode NAT function activated – Firewall function deactivated

Test #9: LAN to WAN with ADSL profile # 2 without any prioritization– routed mode NAT function activated – Firewall function deactivated

Test #10: WAN to LAN with ADSL profile # 1 without any prioritization– routed mode NAT function activated – Firewall function deactivated

Test #11: WAN to LAN with ADSL profile # 2 without any prioritization– routed mode NAT function activated – Firewall function deactivated

5.2.5.1 Test setup

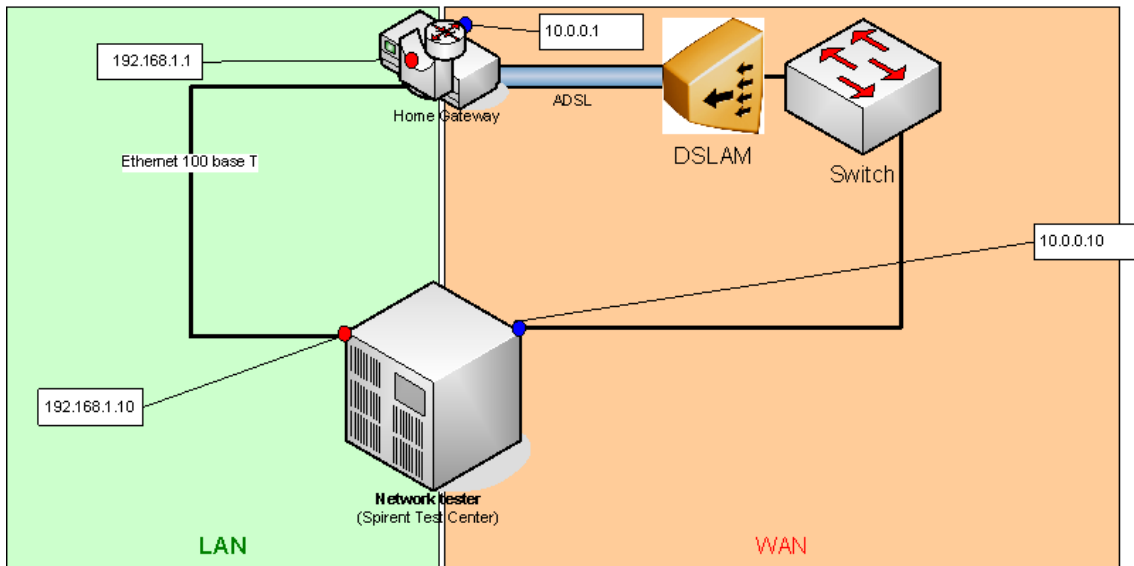


Figure 6: tests #8 & #9 & #10 & #11 setups

5.2.5.2 Test configuration

Home Gateway configuration

- Access interface of the home gateway
 - o The DSL home gateway MUST be compliant with DSL PHY ADSL, ADSL2, and ADSL2+ standards. The home gateway Must be compliant with ADSL over POTS standards:
 - ADSL (ITU-T G.992.1 Annex A better known as G.DMT)
 - ADSL2 (ITU-T G.992.3 Annex A)
 - ADSL2+ (ITU-T G.992.5 Annex A)
 - o DSLAM reference
 - Telindus WAN Access 2400 series based on the following components:
 - Connexant GS3800-808001AAB1Z
 - Connexant GS7566-812-006UZ
 - o synchronised at a fixed rate:
 - **ADSL profile # 1 – 5984 DS / 512 US**
 - **ADSL profile # 2 – 16383 DS / 1024 US**
 - o Single PVC interface – UBR - 8x35
 - o IP/Eth/RFC2684 with LLC/SNAP
 - o Single fixed IP address (10.0.0.1 /255.255.255.0)
 - o Routed forwarding mode
 - o NAPT function activated
 - o Firewall deactivated

Home Gateway Initiative

- LAN interface of the HG
 - o Eth0 – 100 base T full duplex mode, auto negotiation
 - o Single fixed LAN IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration for test #8

STC interface speed is configured in 10 Mbps full duplex auto negotiation mode.
Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]		results
8	66	lower limit	2.95 % ⇔ [226 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	4,05 % ⇔ [310 kbps]	
		initial rate	4,05 % ⇔ [310 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	
	512	lower limit	3.6 % ⇔ [346 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	4,65 % ⇔ [447 kbps]	
		initial rate	4,65 % ⇔ [447 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	
	1024	lower limit	3.6 % ⇔ [353 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	4,65 % ⇔ [455 kbps]	
		initial rate	4,65 % ⇔ [455 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	
	1518	lower limit	3.6 % ⇔ [354 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	4,65 % ⇔ [458 kbps]	
		initial rate	4,65 % ⇔ [458 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	

Network Tester configuration for test #9

STC interface speed is configured in 10 Mbps full duplex auto negotiation mode.
Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]		results
9	66	lower limit	7.1 % ⇔ [544 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	8.3 % ⇔ [636 kbps]	
		initial rate	8.3 % ⇔ [636 kbps]	
		precision	0.5%	
		acc. frame loss	0.1%	
	512	lower limit	8.2 % ⇔ [788 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	9.25 % ⇔ [889 kbps]	
		initial rate	9.25 % ⇔ [889 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	
	1024	lower limit	8.2 % ⇔ [804 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	9.25 % ⇔ [907 kbps]	
		initial rate	9.25 % ⇔ [907 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	
	1518	lower limit	8.2 % ⇔ [808 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	9.25 % ⇔ [912 kbps]	
		initial rate	9.25 % ⇔ [912 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1%	

Home Gateway Initiative

Network Tester configuration for test #10

STC interface speed is configured in 10 Mbps full duplex auto negotiation mode.
Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]		results
10	66	lower limit	46.25 % ⇔ [3549 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	47.35 % ⇔ [3633 kbps]	
		initial rate	47.35 % ⇔ [3633 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1 %	
	512	lower limit	53.1 % ⇔ [5109 kbps]	
		upper limit	54.3 % ⇔ [5224 kbps]	
		initial rate	54.3 % ⇔ [5224 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1 %	
	1024	lower limit	53.1 % ⇔ [5206 kbps]	
		upper limit	54.3 % ⇔ [5324 kbps]	
		initial rate	54.3 % ⇔ [5324 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1 %	
	1518	lower limit	53.1 % ⇔ [5236 kbps]	
upper limit		54.3 % ⇔ [5354 kbps]		
initial rate		54.3 % ⇔ [5354 kbps]		
precision		0.5 %		
acc. frame loss		0.1 %		

Network Tester configuration for test #11

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode.
Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]		results
11	66	lower limit	12 % ⇔ [9208 kbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	13.2 % ⇔ [10129 kbps]	
		initial rate	13.2 % ⇔ [10129 kbps]	
		precision	0.5%	
		acc. frame loss	0.1%	
	512	lower limit	13.7 % ⇔ [13184 kbps]	
		upper limit	14.8 % ⇔ [14243 kbps]	
		initial rate	14.8 % ⇔ [14243 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1 %	
	1024	lower limit	13.7 % ⇔ [13437 kbps]	
		upper limit	14.8 % ⇔ [14516 kbps]	
		initial rate	14.8 % ⇔ [14516 kbps]	
		precision	0.5 %	
		acc. frame loss	0.1 %	
	1518	lower limit	13.7 % ⇔ [13521 kbps]	
upper limit		14.8 % ⇔ [14606 kbps]		
initial rate		14.8 % ⇔ [14606 kbps]		
precision		0.5 %		
acc. frame loss		0.1 %		

5.2.6 Unitary USB tests WAN-LAN

USB2.0 HDD will be reference equipment, provided by the hosting lab, implementing USB2.0 interface, preferably implementing an Oxford SATA to USB2.0 chipset at a minimum of 5400 tr/min. Power supply is external.

The home gateway must implement USB mass storage profile and a file server, (Samba server with a 3.0.28 version as a minimum). This file server is publishing on the LAN the contents stored on the USB2.0 mass storage.

The global size of the downloaded files must be larger than the duration of the test and according to some lab experiences, an amount of information of 100 Gbyte of data is used.

We propose to use a unique share name on Samba server and call it "HGI".

Test #12

12.1 – WAN Ethernet to LAN Ethernet routed mode with PC downloading from USB2.0 attached storage, NAT function activated – Firewall function deactivated

12.2 – LAN Ethernet to WAN Ethernet routed mode with PC downloading from USB2.0 attached storage, NAT function activated – Firewall function deactivated

5.2.6.1 Test setup

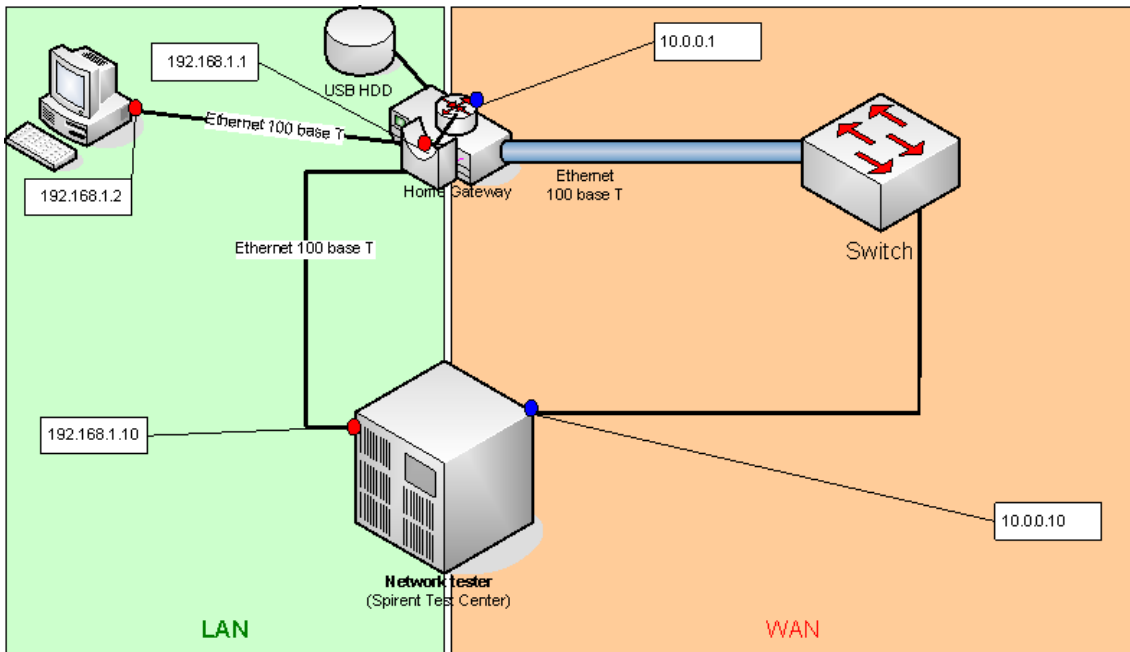


Figure 7: tests #12.1 & #12.2 setup

5.2.6.2 Test configuration

Home Gateway configuration

- access interface
 - o 100 base T full duplex auto-negotiation
 - o IP/Eth
 - o Single fixed IP address (10.0.0.1 /255.255.255.0)
 - o Routed forwarding mode
 - o NAPT function activated
 - o Firewall deactivated
- LAN interface
 - o Eth0 + Eth1 – 100 base T full duplex mode, auto-negotiation

Home Gateway Initiative

- LAN bridge mode (Eth0 + Eth1)
- USB2.0 Host interface.
- Single fixed IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode.
Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]		results
12.1 & 12.2	66	lower limit	98.8 % ⇔ [75,82 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [76,74 Mbps]	
		initial rate	100 % ⇔ [76,74 Mbps]	
		precision	0.5%	
		acc. frame loss	0.1%	
	512	lower limit	98.8 % ⇔ [95,08 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [96,24 Mbps]	
		precision	100 % ⇔ [96,24 Mbps]	
		initial rate	0.5%	
		acc. frame loss	0.1%	
	1024	lower limit	98.8 % ⇔ [96,91 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [98,08 Mbps]	
		precision	100 % ⇔ [98,08 Mbps]	
		initial rate	0.5%	
		acc. frame loss	0.1%	
	1518	lower limit	98.8 % ⇔ [97,51 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [98,69 Mbps]	
		precision	100 % ⇔ [98,69 Mbps]	
		initial rate	0.5%	
		acc. frame loss	0.1%	

5.2.7 Unitary USB tests LAN-LAN

12.3 – LAN Ethernet to LAN Ethernet bridge mode with PC downloading from USB2.0 attached storage

5.2.7.1 Test setup

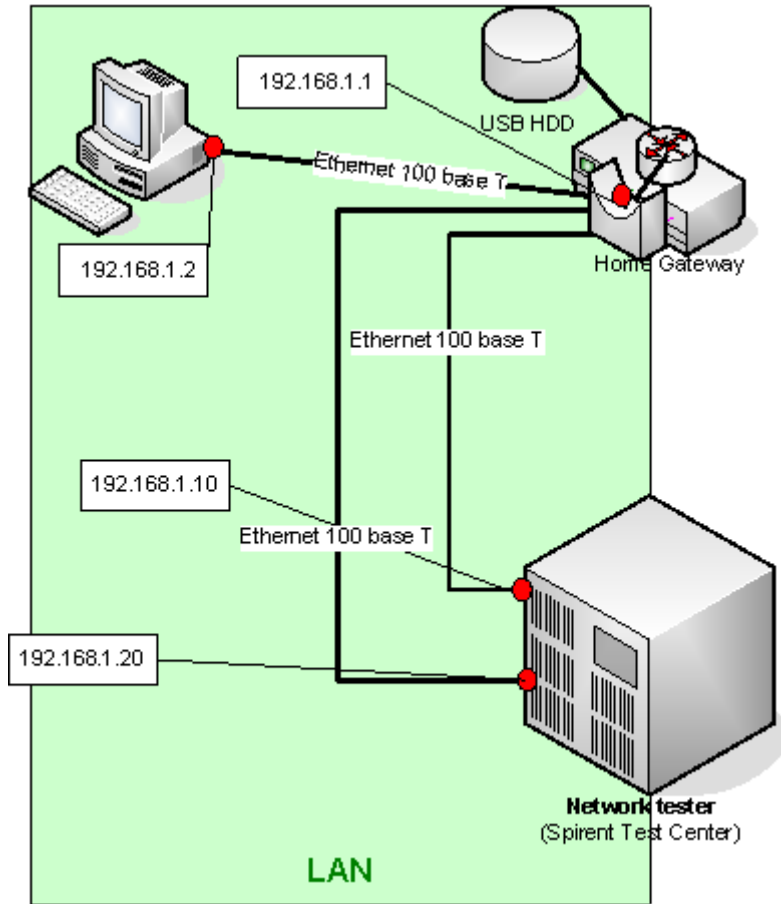


Figure 8: test#12.3 setup

5.2.7.2 Test configuration

Home Gateway configuration

- access interface
 - o NA
- LAN interface
 - o Eth0 + Eth1 + Eth2 – 100 base T full duplex mode, auto-negotiation
 - o LAN bridge mode (Eth0 + Eth1 + Eth2)
 - o USB2.0 Host interface.
 - o Single fixed IP address (192.168.1.1 / 255.255.255.0)

Network Tester configuration

STC interface speed is configured in 100 Mbps full duplex auto negotiation mode. Traffic load for throughput and latency search is configured as follow:

test #	frame size	test conf in % and [corresponding Eth birate]	results
12.3	66	lower limit	98.8 % ⇔ [75,82 Mbps]
		upper limit	100 % ⇔ [76,74 Mbps]
		initial rate	100 % ⇔ [76,74 Mbps]
		precision	0.5%
		acc. frame loss	0.1%
	512	lower limit	98.8 % ⇔ [95,08 Mbps]
		upper limit	100 % ⇔ [96,24 Mbps]
		precision	100 % ⇔ [96,24 Mbps]
		initial rate	0.5%
		acc. frame loss	0.1%
			[FAILED]* or [PASS with fps & latency]
			[FAILED]* or [PASS with fps & latency]

Home Gateway Initiative

	1024	lower limit	98.8 % ⇔ [96,91 Mbps]	[FAILED]* or [PASS with fps & latency]
		upper limit	100 % ⇔ [98,08 Mbps]	
		precision	100 % ⇔ [98,08 Mbps]	
		initial rate	0.5%	
		acc. frame loss	0.1%	
	1518	lower limit	98.8 % ⇔ [97,51 Mbps]	
		upper limit	100 % ⇔ [98,69 Mbps]	
		precision	100 % ⇔ [98,69 Mbps]	
		initial rate	0.5%	
		acc. frame loss	0.1%	

6 QoS test specification

6.1 Traffic description

Note 1: All TCP/UDP port mapping are defined with pre configured rules in the home gateway.

Note 2: VoIP traffic definition is

- G711 with 20 ms of payload (160 payload bytes)
- 80 kbps at IP level
- All Payload packets are encapsulated in an RTP frame

Note 3: AV traffic definition is:

- In the downstream AV traffic is encapsulated in MPEG2 TS frames, which corresponds to an IP datagram size of 1300 bytes. Bitrate for Standard Definition Traffic is 4Mbps and 12 Mbps for High Definition one.
- In the upstream, traffic is mainly TCP ack traffic (portal access) and other operation and maintenance traffic.

Direction	Ref	DSCP marking	Type of flow	Source IP -> Destination IP	Protocol	Source port -> Dest port	IP datagram size (Bytes)	Rate (from the source)
WAN TO LAN	1	WAN: EF LAN: CS7	VOIP (managed)	10.0.0.10 -> 192.168.1.10	UDP	10002 -> 10000	200	~80 kbps
	2	WAN: AF31 LAN: CS4	AV HD (managed)	10.0.0.20 -> 192.168.1.20	UDP	1024 -> 22222	1300	~12 Mbps
	3	WAN: AF31 LAN: CS4	AV SD (managed)	10.0.0.20 -> 192.168.1.20	UDP	1025 -> 22223	1300	~4 Mbps
	4	WAN: AF21 LAN: CS2	Premium data (managed)	10.0.0.30 -> 192.168.1.30	TCP	3333 -> 33333	~1300	~100 kbps
	5	WAN: BE LAN: BE	Internet (managed)	10.0.0.40 -> 192.168.1.40	TCP	4444 -> 44444	~300-500	varying
LAN TO WAN	6	WAN: EF LAN: CS7	VOIP (managed)	192.168.1.10 -> 10.0.0.10	UDP	10000 -> 10002	200	~80 kbps
	7	WAN: AF31 LAN: CS4	AV portal access, EPG... (managed)	192.168.1.20 -> 10.0.0.20	TCP	22222 -> 1024	64	~200 kbps
	8	WAN: AF21 LAN: CS2	Premium data (managed)	192.168.1.30 -> 10.0.0.30	TCP	33333 -> 3333	~64	~100 kbps
	9	WAN: BE LAN: BE	Internet (managed)	192.168.1.40 -> 10.0.0.40	TCP	44444 -> 4444	~300-500	varying
LAN TO LAN	10	WAN: NA LAN: NA	Local flow (unmanaged)	192.168.1.60 -> 192.168.1.50	UDP	NA	~1350	~90 Mbps
	11	WAN: NA LAN: BE, remarked in the HG based on the MAC@	Local flow with USB attached device (unmanaged)	Internally generated traffic -> 192.168.1.2	Samba traffic	NA	~1300 ~ 64	~ high performance USB2.0 HDD provided by hosting lab
	12	WAN: NA LAN: based on the specific MAC@	Local flow (managed)	192.168.1.70 -> 192.168.1.50	UDP	NA	~1350	~12 Mbps

Table 2 : Traffics description

6.2 Egress LAN Ethernet interface

6.2.1 Test objective

As described in **Figure 9: Egress LAN Ethernet interface**~~Figure 8: Egress LAN Ethernet interface~~ the objective of this test is to generate a congestion point on one of the Ethernet LAN interfaces between downstream managed flows and LAN to LAN traffic in the case where LAN to LAN traffic is UDP traffic.

6.2.2 Queue configuration on Ethernet interface

Application	Flow	HG QOS req	Service Signature	Queue
VoIP (managed)	10.0.0.10 -> 192.168.1.10	WAN-LAN	SBC SA (10.0.0.10) AND WAN EF DSCP remarked to CS7 on the LAN	LAN SP1
AV HD (managed)	10.0.0.20 -> 192.168.1.20	WAN-LAN	AV SPF SA (10.0.0.20) AND WAN AF31 DSCP remarked to CS4 on the LAN	LAN SP2
AV SD (managed)	10.0.0.20 -> 192.168.1.20	WAN-LAN	AV SPF SA (10.0.0.20) AND WAN AF31 DSCP remarked to CS4 on the LAN	LAN SP2
Internet traffic	10.0.0.40 -> 192.168.1.40	WAN-LAN	WAN DSCP remarked to BE on the LAN	LAN SP3
LAN to LAN (unmanaged)	192.168.1.60 -> 192.168.1.50	LAN-LAN	NA	LAN SP3
LAN to LAN (managed)	192.168.1.70 -> 192.168.1.50	LAN-LAN	Specific Src MAC@: 00:10:94:10:00:01	LAN SP2

Table 3: Queue configuration, Egress LAN Ethernet

6.2.3 Test Setup

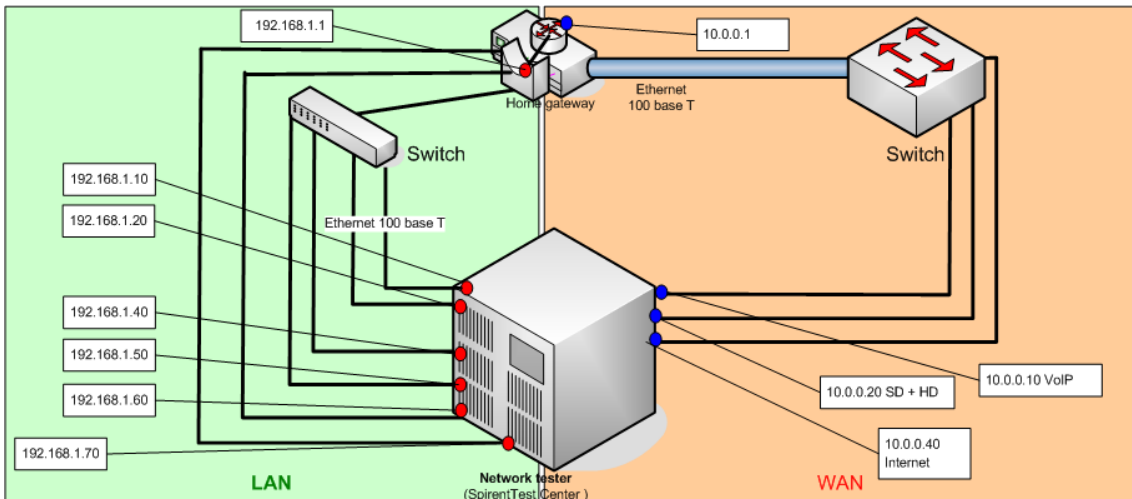


Figure 9: Egress LAN Ethernet interface

6.2.4 Classification sequence description

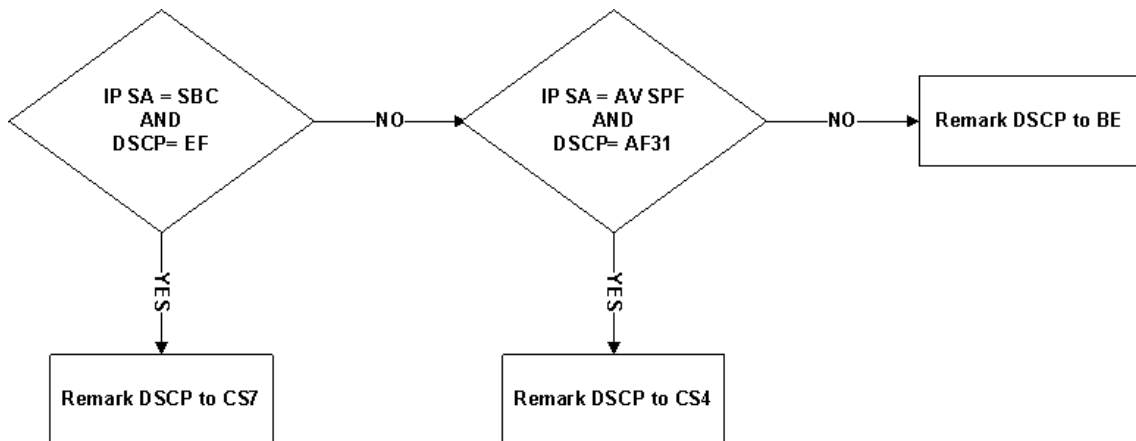


Figure 10: classification sequence for Egress LAN Ethernet

6.2.5 Test description

6.2.5.1 VoIP traffic

Test #13: - Send corresponding traffic (VoIP as defined in [Table 3: Queue configuration, Egress LAN Ethernet](#)) -> Voice traffic remarked at CS7 marking - Yes / No

Test #14: - Change DSCP value (AF31) -> Voice traffic with BE marking - Yes / No

6.2.5.2 AV traffic

Test #15: - Send corresponding traffic (AV as defined in [Table 3: Queue configuration, Egress LAN Ethernet](#)) -> AV traffic remarked at CS4 marking - Yes / No

Test #16: - Change DSCP value (EF) -> AV traffic with BE marking - Yes / No

6.2.5.3 Internet traffic

Test #17: - Send corresponding traffic marked with AF11 DSCP value (Internet traffic as defined in [Table 3: Queue configuration, Egress LAN Ethernet](#)~~Table 3: Queue configuration, Egress LAN Ethernet~~) -> Internet traffic remarked with BE marking - Yes / No

6.2.5.4 LAN to LAN traffic

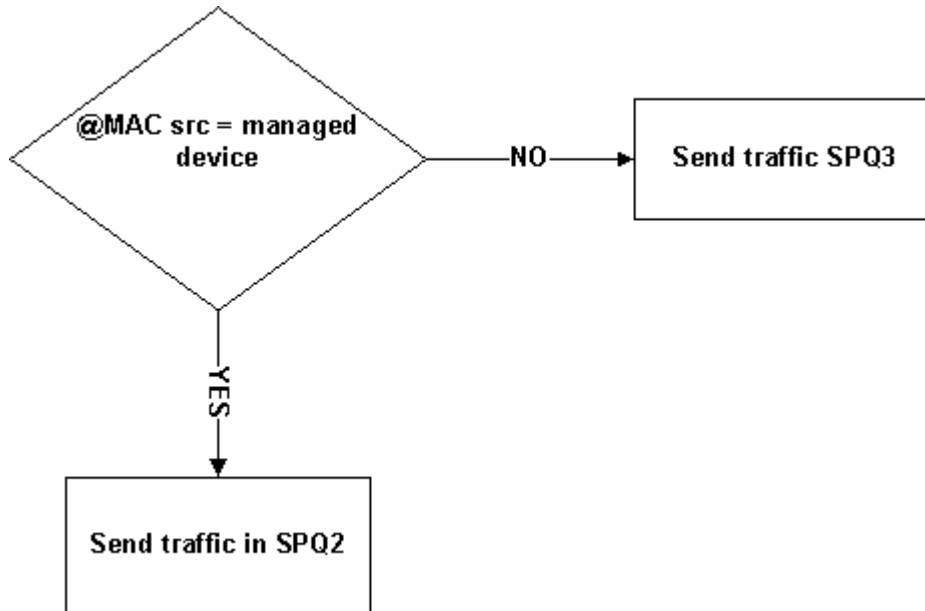


Figure 11: LAN to LAN Egress LAN Ethernet

Test #18: - Send corresponding LAN to LAN traffics (LAN to LAN traffic managed and unmanaged as defined in [Table 3: Queue configuration, Egress LAN Ethernet](#)~~Table 3: Queue configuration, Egress LAN Ethernet~~) -> no packet loss occurs on LAN to LAN managed traffic when unmanaged traffic saturates Bandwidth- Yes / No

6.2.5.5 Multiservice tests

Test # 19: - Send traffic VoIP, AV, Internet, LAN to LAN unmanaged as defined in [Table 3: Queue configuration, Egress LAN Ethernet](#)~~Table 3: Queue configuration, Egress LAN Ethernet~~. Test duration is 60 minutes.

Each VoIP call will last 4 minutes with 1 minute between each call.

For VoIP traffic

- Packet Loss Ratio < 1 %
- Inter Packet Delay Variation : 99.9 % of packets must be less than 60 ms distant each others
- R factor - E Model (ITU G.107) >= 90

All parameters are respected - Yes / No

For AV traffic

The measurement is limited to SD flows for timing constraints.

According to TR126:

- Only one burst of errors per hour and burst duration must be limited to 16 ms

- Inter Packet Delay Variation : 100 % of packets must be less than 50 ms apart from each other

All parameters are respected – Yes / No

6.3 Egress LAN Wi-Fi interface

6.3.1 Test objective

The objective of this test is to generate a congestion point on the Wi-Fi interface and test the prioritisation mechanism.

6.3.2 Queue configuration on Wi-Fi interface

Application	Flow	HG QOS req	Service Signature	Queue
VoIP (managed)	10.0.0.10 -> 192.168.1.10	WAN-LAN	SBC SA (10.0.0.10) SA AND WAN EF DSCP remarked to CS7 on the LAN	LAN AC_VO
AV SD (managed)	10.0.0.20 -> 192.168.1.20	WAN-LAN	VoD SPF SA (10.0.0.20) AND WAN AF31 DSCP remarked to CS4 on the LAN	LAN AC_VI
Internet traffic	10.0.0.40 -> 192.168.1.40		WAN DSCP remarked to BE on the LAN	LAN AC_BE
LAN to LAN (unmanaged)	192.168.1.60 -> 192.168.1.50		NA	LAN AC_BE
LAN to LAN (managed)	192.168.1.70 -> 192.168.1.50	LAN-LAN	Specific Src MAC@: 00:10:94:10:00:01	LAN AC_VI

Table 4 : Queue configuration on Wi-Fi interface

6.3.3 Test Setup

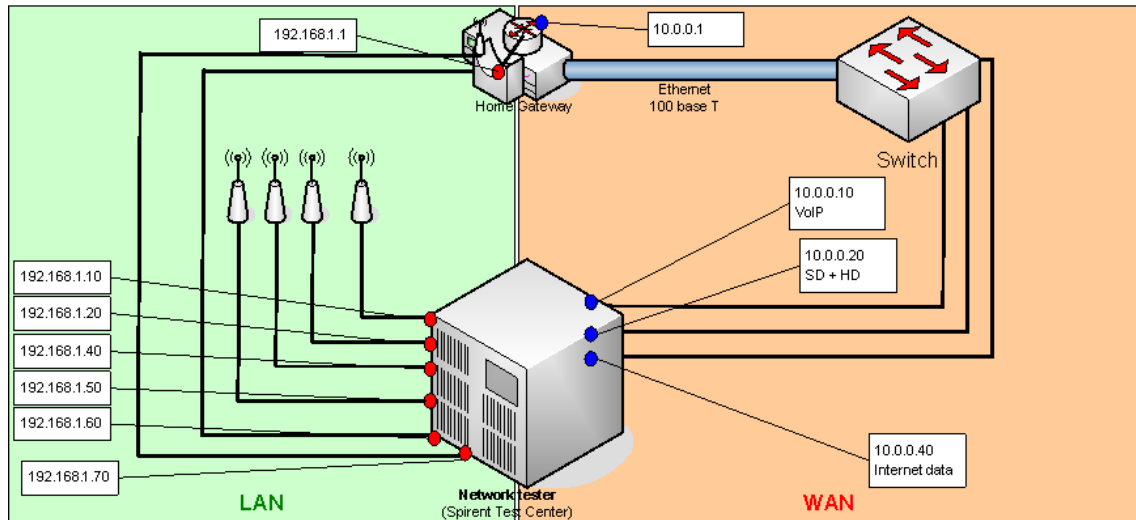


Figure 12: Egress WI-FI interface

Test configurations that include **Wi-Fi equipment**, Wi-Fi version is 802.11g with WPA2 security activated value of "HOMEGATEWAYINITIATIVETESTEVEN" and a single SSID value of HGITESTEVENT1 or HGITESTEVENT2 or PREHGITESTEVENT

Access point is configured as such that the 54 Mbps Wi-Fi profile is forced.

6.3.4 Classification sequence description

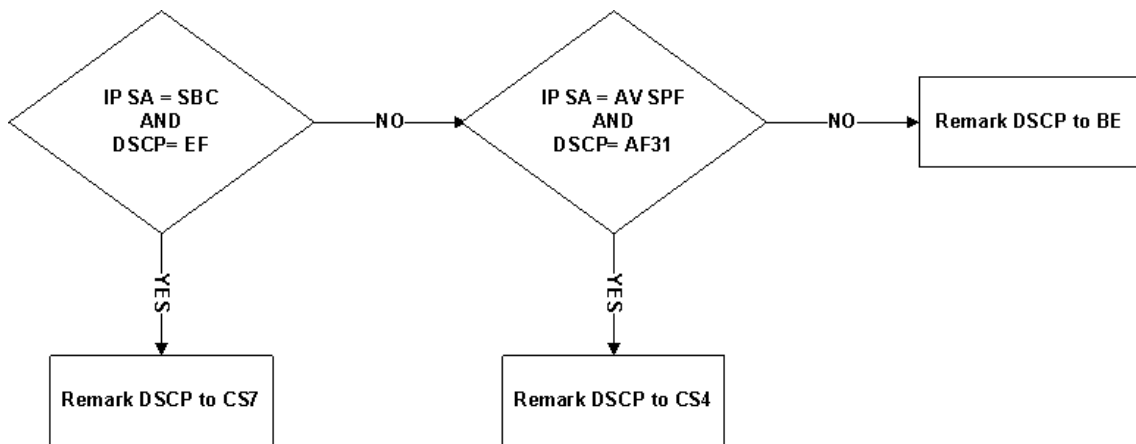


Figure 13: classification sequence for Egress LAN WI-FI

6.3.5 Test description

6.3.5.1 VoIP traffic

Test #20: - Send corresponding traffic (VoIP as defined in [Table 4 : Queue configuration on Wi-Fi interface](#)[Table 4 : Queue configuration on Wi-Fi interface](#)) -> Voice traffic remarked at CS7 marking - Yes / No

Test #21: - Change DSCP value (AF31) -> Voice traffic with BE marking - Yes / No

6.3.5.2 AV traffic

Test #22: - Send corresponding traffic (AV as defined in [Table 4 : Queue configuration on Wi-Fi interface](#)[Table 4 : Queue configuration on Wi-Fi interface](#)) -> AV traffic remarked at CS4 marking - Yes / No

Test #23: - Change DSCP value (EF) -> AV traffic with BE marking – Yes / No

6.3.5.3 Internet traffic

Test #24: - Send corresponding traffic marked with AF11 DSCP value (Internet traffic as defined in [Table 4 : Queue configuration on Wi-Fi interface](#)~~Table 4 : Queue configuration on Wi-Fi interface~~) -> Internet traffic remarked with BE marking – Yes / No

6.3.5.4 LAN to LAN traffic

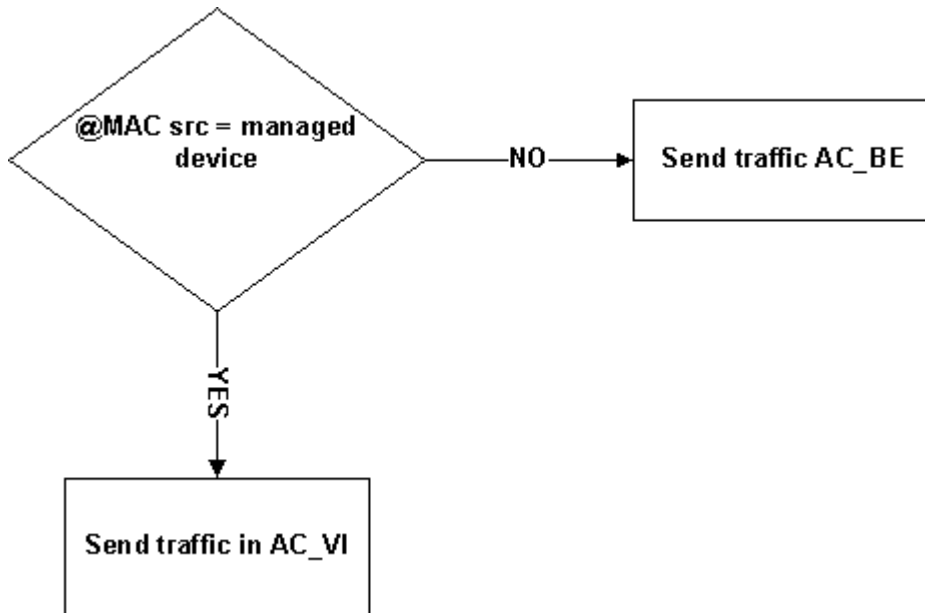


Figure 14 : LAN to LAN traffic classification, marking and queueing

Test #25: - Send corresponding LAN to LAN traffics (LAN to LAN traffic managed and unmanaged as defined in [Table 4 : Queue configuration on Wi-Fi interface](#)~~Table 4 : Queue configuration on Wi-Fi interface~~) -> no packet loss occurs on LAN to LAN managed traffic when unmanaged traffic saturates Bandwidth– Yes / No

6.3.5.5 Multiservice tests

Test # 26 – Send traffics VoIP, AV, Internet, LAN to LAN unmanaged as defined in [Table 4 : Queue configuration on Wi-Fi interface](#)~~Table 4: Queue configuration on Wi-Fi interface~~. **Test duration is 60 minutes.**

Each VoIP call will last 4 minutes with 1 minute between each call.

For VoIP traffic

- Packet Loss Ratio < 1 %
- Inter Packet Delay Variation : 99.9 % of packets must be less than 60 ms distant each others
- R factor – E Model (ITU G.107) >= 90

All parameters are respected – Yes / No

For AV traffic.

The measurement is limited to SD flows for timing constraints.

According to TR126:

- Only one burst of errors per hour and burst duration must be limited to 16 ms
- Inter Packet Delay Variation : 100 % of packets must be less than 50 ms distant each others

All parameters are respected – Yes / No

6.4 USB attached storage

6.4.1 Test objective

The objective of this test is to mix LAN to LAN traffic, with internally generated traffic from a USB source attached to the home gateway and monitor the effect on managed services.

6.4.2 Test description

A PC is connected on a free Ethernet port 100 baseT full duplex of the HG and a USB HDD attached on the USB2.0 Host interface of the home gateway.

USB2.0 HDD will be reference equipment, provided by the hosting lab, implementing USB2.0 interface, preferably implementing an Oxford SATA to USB2.0 chipset at a minimum of 5400 tr/min. Power supply is external.

The home gateway must implement USB mass storage profile and a file server, (Samba server with a 3.0.28 version as a minimum). This file server is publishing on the LAN the contents stored on the USB2.0 mass storage.

The global size of the downloaded files must be larger than the duration of the test and according to some lab experiences, an amount of information of 100 Gbytes of data is used.

6.4.3 Queue configuration on Ethernet interface

Application	Flow	HG QOS req	Service Signature	Queue
VoIP (managed)	10.0.0.10 -> 192.168.1.10	WAN-LAN	SBC SA (10.0.0.10) AND WAN EF DSCP remarked to CS7 on the LAN	LAN SP1
AV HD (managed)	10.0.0.20 -> 192.168.1.20	WAN-LAN	AV SPF SA (10.0.0.20) AND WAN AF31 DSCP remarked to CS4 on the LAN	LAN SP2
AV SD (managed)	10.0.0.20 -> 192.168.1.20	WAN-LAN	AV SPF SA (10.0.0.20) AND WAN AF31 DSCP remarked to CS4 on the LAN	LAN SP2
Internet traffic	10.0.0.40 ->	WAN-LAN	WAN DSCP remarked to BE on the LAN	LAN SP3

	192.168.1.40			
LAN to LAN (unmanaged)	192.168.1.60 -> 192.168.1.50	LAN-LAN	NA	LAN SP3

Table 5: traffic description, USB attached storage

6.4.4 Test setup

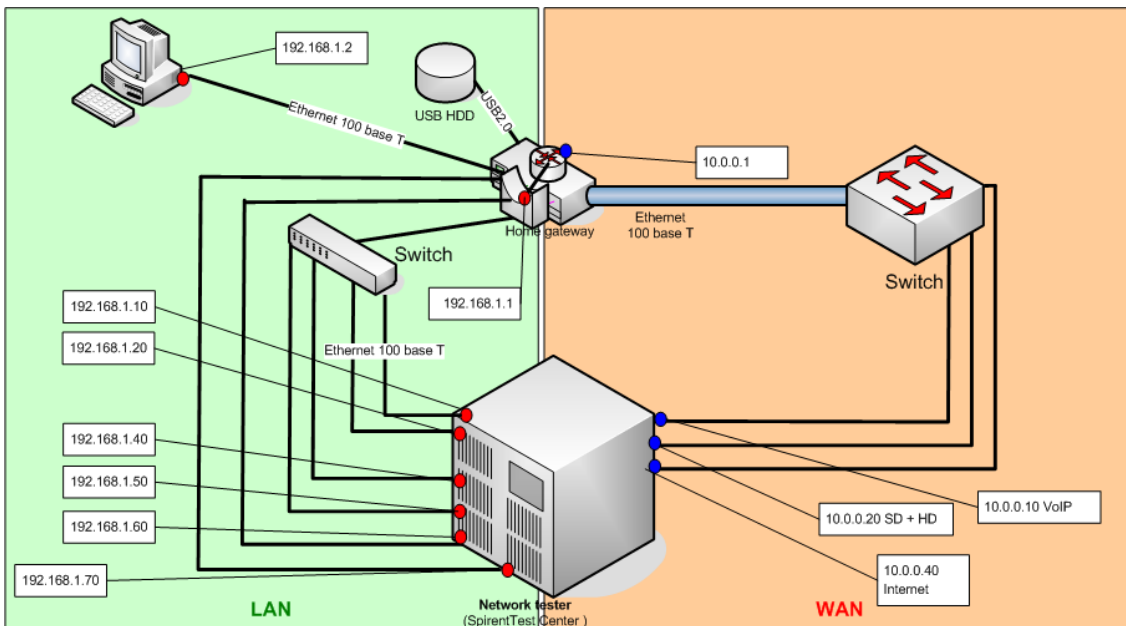


Figure 15: USB attached storage

Test #27:

Launch all WAN to LAN flows: VoIP, AV, Internet traffic as defined in [Table 5: traffic description, USB attached storage](#)

Launch LAN to LAN unmanaged traffic (defined in [Table 5: traffic description, USB attached storage](#))

PC is simultaneously downloading files from USB2.0 HDD.

Test duration is limited to 60 minutes.

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Each VoIP call will last 4 minutes with 1 minute between each call.

For VoIP traffic

- Packet Loss Ratio < 1 %
- Inter Packet Delay Variation : 99.9 % of packets must be less than 60 ms distant each others
- R factor – E Model [7] >= 90

All parameters are respected – Yes / No

For AV traffic,

The measurement is limited to SD flows for timing constraints and according to [6]:

- Only one burst of errors per hour and burst duration must be limited to 16 ms
- Inter Packet Delay Variation : 100 % of packets must be less than 50 ms distant each others

All parameters are respected – Yes / No

6.5 Egress WAN test configuration / ADSL

6.5.1 Test objective

The objective of this test is to generate a congestion point on the upstream direction of the WAN ADSL egress interface with VoIP, AV, Premium data and data traffic.

Only ADSL profile #1 is tested, (**ADSL profile # 1 – 5984 DS / 512 US**).

6.5.2 Queue configuration on WAN interface

Application	Flow	HG QOS req	Service Signature	Queue
VoIP (managed)	192.168.1.10 -> 10.0.0.10	LAN-WAN	SBC DA (10.0.0.10) AND LAN CS7 DSCP remarked to EF on WAN	WAN SP1
AV (managed)	192.168.1.20 -> 10.0.0.20	LAN-WAN	AV SPF DA (10.0.0.20) AND LAN CS4 DSCP remarked to AF31 on WAN	WAN WRR1
Premium data (managed)	192.168.1.30 -> 10.0.0.30	LAN-WAN	DA SEGW (10.0.0.30) AND LAN CS2 DSCP remarked to AF21 on WAN	WAN WRR2
Data Traffic	192.168.1.40 -> 10.0.0.40	LAN-WAN	LAN DSCP remarked to BE on WAN	WAN WRR3

Table 6: Queue configuration on WAN egress

6.5.3 Test setup

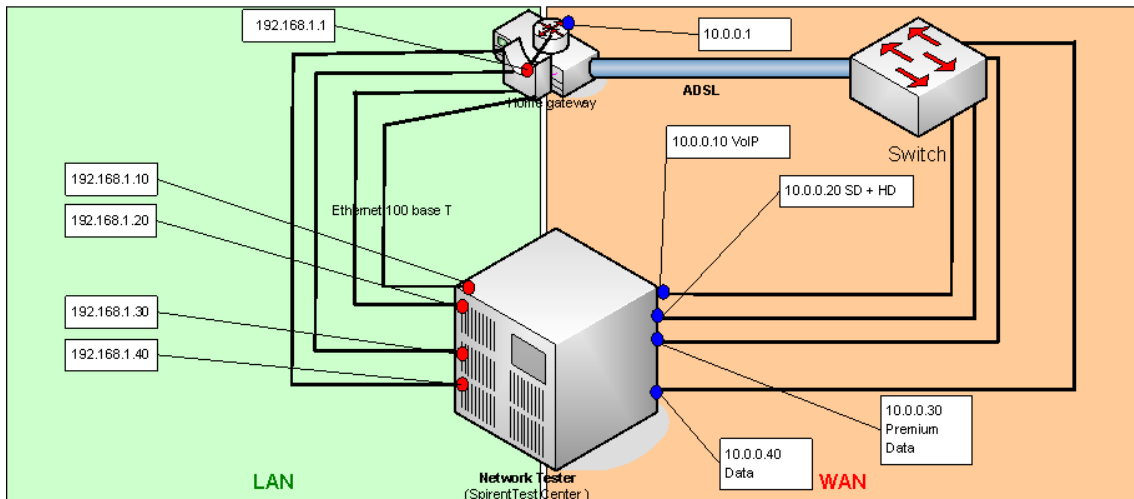


Figure 16: Egress WAN test setup

6.5.4 Test description

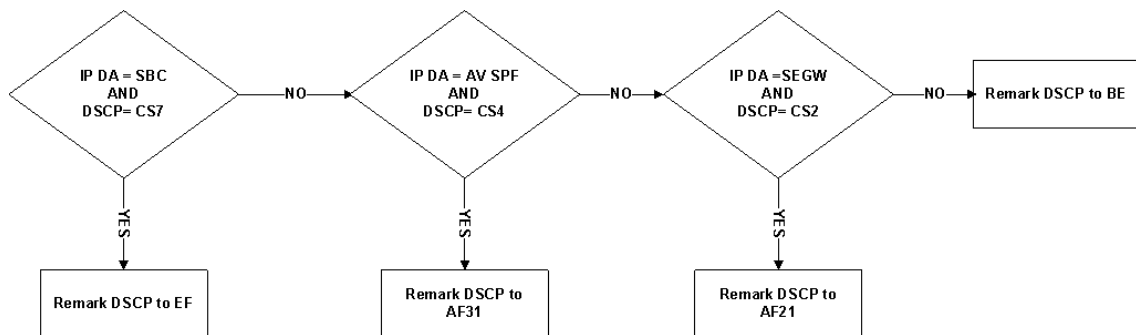


Figure 17: egress wan classification

6.5.4.1 VoIP

Test #28: - Send corresponding traffic (VoIP as defined in [Table 6: Queue configuration on WAN egress](#)[Table 6: Queue configuration on WAN egress](#)) -> Voice traffic remarked at EF marking - Yes / No

Test #29: - Change DSCP value (CS4) -> Voice traffic with BE marking - Yes / No

6.5.4.2 AV

Test #30: - Send corresponding traffic (AV as defined in [Table 6: Queue configuration on WAN egress](#)[Table 6: Queue configuration on WAN egress](#)) -> AV traffic remarked at AF31 marking - Yes / No

Test #31: - Change DSCP value (CS2) -> AV traffic with BE marking - Yes / No

6.5.4.3 Premium data

Test #32: - Send corresponding traffic (Premium data as defined in [Table 6: Queue configuration on WAN egress](#)[Table 6: Queue configuration on WAN egress](#)) -> Premium data traffic remarked at AF21 marking - Yes / No

Test #33: - Change DSCP value (AF33) -> Premium data traffic with BE marking - Yes / No

6.5.4.4 Data

Test #34 - Send corresponding traffic (Data as defined in [Table 6: Queue configuration on WAN egress](#)~~Table 6: Queue configuration on WAN egress~~) -> Data traffic remarked at BE marking - Yes / No

6.5.4.5 Multi-service

**Test # 35: - Launch all LAN to WAN flows (VoIP, AV, Premium data and Data traffics as defined in [Table 6: Queue configuration on WAN egress](#)~~Table 6: Queue configuration on WAN egress~~),
Test duration is 30 minutes.**

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Each VoIP call will last 4 minutes with 1 minute between each call.

For VoIP traffic

- Packet Loss Ratio < 1 %
- Inter Packet Delay Variation : 99.9 % of packets must be less than 60 ms distant each others
- R factor - E Model [7] >= 90

All parameters are respected - Yes / No

7 Multiple session test cases / Ethernet test setup

7.1 Rationale

As explained in section 8.2 of [5] P2P applications may be dangerous for home gateway processing if nothing is performed at the home gateway level. The main issue is linked to the high number of active sessions simultaneously admitted in the home gateway that may lead to a home gateway crash. The objective of the multisession test is to determine the maximum number of active sessions that the home gateway can support without any performance issue. This number (M) is fixed at 2000 in [5].

7.2 Test setup

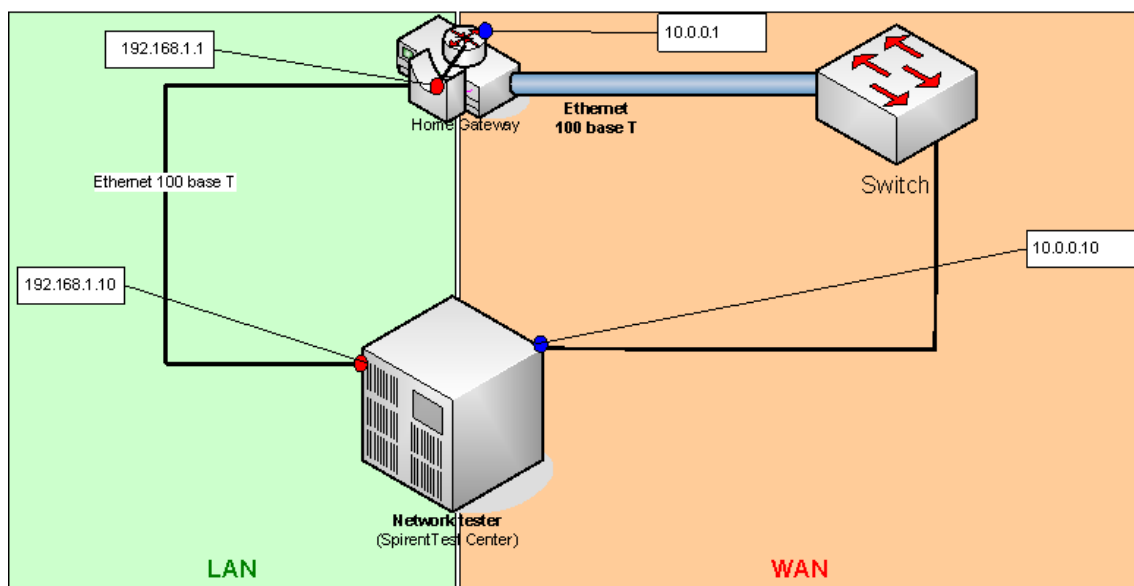
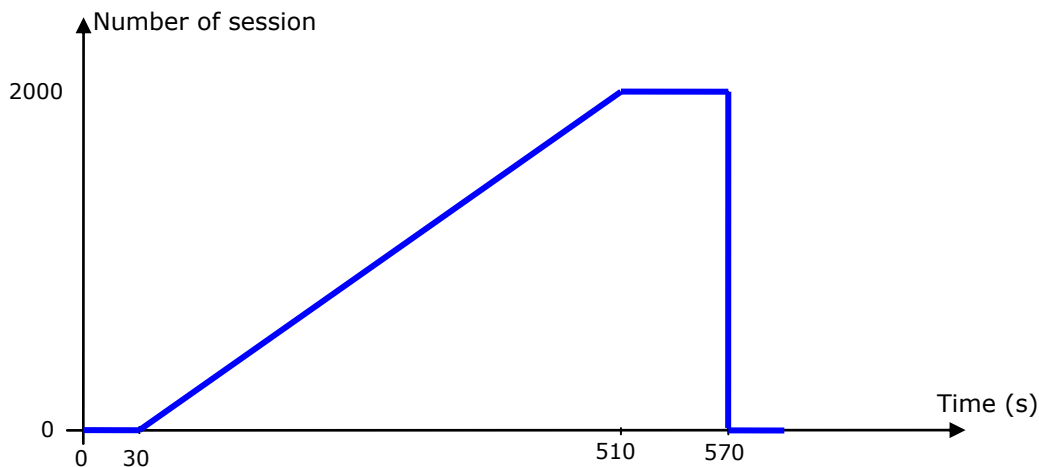


Figure 18: multisession test setup

7.3 Test description

As explained in [5], M is the total number of active sessions that the system is supporting. The objective of multi-session test is to determine M. Assuming a maximum Ethernet throughput of 60Mbps (4876 Fps) and a value 2000 for M the bitrate of each session is $60 / 2000 = 30$ kbps (2,4 Fps). The Ethernet frame size is fixed at 1518 bytes. To reach M the number of simultaneous TCP session is increase linearly during 8 minutes, then the max number M is maintain during 1 minute.



The test set up will be based on the one described in the figure above, a single LAN port and a single WAN port of the home gateway are used.

Test # 36: – Launch LAN to WAN TCP traffic with the three message handshake⁽¹⁾ and increase the number of active sessions up to M. M is fixed at a value of 2000

A rate under 0.1% of TCP session failed before M – Yes / No

If yes note the maximum number of TCP sessions supported

Test # 37: – Launch WAN to LAN TCP traffic with the three message handshake⁽²⁾ and increase the number of active sessions up to M. M is fixed at a value of 2000.

A rate under 0.1% of TCP session failed before M – Yes / No

If yes note the maximum number of TCP sessions supported

In these two tests the three messages handshake refer to the three TCP messages exchanged at the opening of a TCP session (e.g, [SYN], [SYN/ACK], [ACK])

In test #36 the three message handshake is initiated from WAN side. The firsts TCP SYN messages are originated by the WAN side, they could be discarded by the HGW if no redirection rule is configured. A redirection rule is needed.

In test #37 the three message handshake is initiated from LAN side.

8 Energy saving tests

The objective of this test is to test the home gateway for its compliancy with the low power state of the Code of Conduct on Energy Consumption of Broadband Equipment, Version 3 as described in [9].

For this test we use the following equipment:

- Power source: Chroma 6530
- power meter: Fluke 43B combined with a 80I-110s AC/DC current clamp probe

Specifications of this equipment is given in annex 10.3.

9 Correlation between tests and HGI requirements

These tests are derived from the following HGI requirements [8] :

R54, R354, R355, R356, R359, R361, R366, R367, R376, R377, R379 , R380, R381, R382, R385, R390, R394, R399, R400, R433, R435, R441, R444, R452, , R460, R461, R463, R464, R465, R466, R467, R468 R470, R471, R472, R473, R475, R476, R477, R480, R481

10 References

- [1]: HGI 01190: " Call for participation in the first HGI test event"
- [2]: IETF RFC 2544:"Benchmarking Methodology for Network Interconnect Devices"
- [3]: IETF RFC 1242: "Benchmarking Terminology for Network Interconnection Devices"
- [4]: HGI01284: Test Event NDA
- [5]: HGI01041R05: "requirements for the HG related to P2P traffic and multiple sessions"
- [6]: BBF TR-126: " triple play services quality of experience (QoE) requirements"
- [7]: ITU-T G.107: " The E-model, a computational model for use in transmission planning"
- [8]: Home Gateway technical requirements version 1.0
- [9]: HGI01280: " Test Specification CoC low power test case"

11 Annex

11.1 E model and R factor values

User Satisfaction Level	MOS	R-Factor
Very satisfied	4.3-5.0	90-100
Satisfied	4.0-4.3	80-90
Some users satisfied	3.6-4.0	70-80
Many users dissatisfied	3.1-3.6	60-70
Nearly all users dissatisfied	2.6-3.1	50-60
Not recommended	1.0-2.6	Less than 50

Table 7: Emodel description

11.2 Results sheet example

For one vendor all results will be given in one excel file with 5 different sheets:

- The first one referring to the NDA [4]
- one for each kind of test (unitary, multi service, multi session).
- And the last one for the energy saving

An example is the following file:



HGI-TE-vendor-x-res
ults-CONFIDENTIAL.z

With 'x' as a number

11.3 Power equipment specifications

11.3.1 Power source: Chroma 6530

Model	6512	6520	6530	6560	6590
Output/ Phase	1	1	1	1 (parallel or series)	1 or 3 selectable
OUTPUT RATINGS					
Power/Phase	1200VA	2000VA	3000VA	6000VA	3000VA
Voltage					
Range/phase	150V / 300V / Auto	150V / 300V / Auto	150V / 300V / Auto	150V / 300V (parallel) 300V / 500V (series)	150V / 300V
Accuracy	0.5% of F.S. (15~45 Hz) 0.2% of F.S. (>45~2K Hz)	0.5% of F.S. (15~45 Hz) 0.2% of F.S. (>45~2K Hz)	0.5% of F.S. (15~45 Hz) 0.2% of F.S. (>45~2K Hz)	0.2% of F.S.	0.2% of F.S.
Resolution	0.1V	0.1V	0.1V	0.1V	0.1V
Distortion ¹	1% (15~45 Hz) 0.5% (> 45~500 Hz) 1% (> 500~1K Hz) 2% (> 1K~2K Hz)	1% (15~45 Hz) 0.5% (> 45~500 Hz) 1% (> 500~1K Hz) 2% (> 1K~2K Hz)	1% (15~45 Hz) 0.5% (> 45~500 Hz) 1% (> 500~1K Hz) 2% (> 1K~2K Hz)	1% (45~1K Hz)	1% (45~1K Hz)
Line Regulation	0.1%	0.1%	0.1%	0.1%	0.1%
Load Regulation ²	0.1%	0.1%	0.1%	0.2% (series) 0.8% (parallel)	0.2%
Temp. Coefficient	0.02% per°C	0.02% per°C	0.02% per°C	0.02% per°C	0.02% per°C
Max. Current/Phase					
rms peak	12A/6A (150V / 300V) 36A/18A(15~100Hz) 30A/15A(>100~1KHz) 24A/12A(>1K~2KHz)	20A/10A (150V / 300V) 60A/30A(15~100Hz) 50A/25A(>100~1KHz) 40A/20A(>1K~2KHz)	30A/15A (150V / 300V) 90A/45A(15~100Hz) 75A/38A(>100~1KHz) 60A/30A(>1K~2KHz)	60/30/15 A(150/300/500V) 90/90/45 A(45~100Hz) 50/75/38 A(>100~1KHz)	30A (150V / 300V) 90A/45A(45~100Hz) 75A/38A(>100~1KHz)
Frequency					
Range	15 ~ 2K Hz	15 ~ 2K Hz	15 ~ 2K Hz	15 ~ 1K Hz	45 ~ 1K Hz
Accuracy	0.15%	0.15%	0.15%	0.15%	0.15%
Resolution	0.01 Hz (15~99.9 Hz) 0.1 Hz (100~999.9 Hz) 0.2 Hz (1K ~ 2K Hz)	0.01 Hz (15~99.9 Hz) 0.1 Hz (100~999.9 Hz) 0.2 Hz (1K ~ 2K Hz)	0.01 Hz (15~99.9 Hz) 0.1 Hz (100~999.9 Hz) 0.2 Hz (1K ~ 2K Hz)	0.01 Hz (45~99.9Hz) 0.1 Hz (100~999.9 Hz)	0.01 Hz (45~99.9Hz) 0.1 Hz (100~999.9 Hz)
INPUT RATINGS					
Voltage Range	190 ~ 250 V,1ø	190 ~ 250 V,1ø	190 ~ 250 V,1ø	190 ~ 250 V, 3ø	190 ~ 250 V, 3ø
Frequency Range	47 ~ 63 Hz	47 ~ 63 Hz	47 ~ 63 Hz	47 ~ 63 Hz	47 ~ 63 Hz
Current	10A max.	15A max.	23A max.	35A max./phase	35A max./phase
Power Factor	0.95 min. under full load	0.97 min. under full load	0.98 min. under full load	-	0.98 min. under full load
MEASUREMENT					
Voltage/Phase					
Range	0 ~ 150V / 0 ~ 300V	0 ~ 150V / 0 ~ 300V	0 ~ 150V / 0 ~ 300V	0 ~ 150V / 0 ~ 300V	0 ~ 150V / 0 ~ 300V
Accuracy (rms)	0.1% F.S. + 0.25%	0.1% F.S. + 0.25%	0.1% F.S. + 0.25%	0.1% F.S. + 0.25%	0.1% F.S. + 0.25%
Resolution	0.1V	0.1V	0.1V	0.1V	0.1V
Current/Phase					
Range (peak)	0 ~ 60 A	0 ~ 100 A	0 ~ 140 A	0 ~ 140 A	0 ~ 140 A
Accuracy (rms)	0.25% F.S. + 0.4%	0.15% F.S. + 0.4%	0.1% F.S. + 0.4%	0.1% F.S. + 0.4%	0.1% F.S. + 0.4%
Accuracy (peak)	0.5% F.S. + 0.4%	0.3% F.S. + 0.4%	0.2% F.S. + 0.4%	0.2% F.S. + 0.4%	0.2% F.S. + 0.4%
Resolution	0.01A	0.01A	0.01A	0.01A	0.01A
Power/Phase					
Accuracy	1% F.S. (CF<6)	1% F.S. (CF<6)	1% F.S. (CF<6)	1% F.S. (CF<6)	1% F.S. (CF<6)
Resolution	0.01W	0.01W	0.01W	0.01W	0.01W
Frequency					
Range	15 ~ 2K Hz	15 ~ 2K Hz	15 ~ 2K Hz	15 ~ 1K Hz	45 ~ 1K Hz
Accuracy	0.01% +2 count	0.01% +2 count	0.01% +2 count	0.01% +2 count	0.01% +2 count
Resolution	0.01Hz	0.01Hz	0.01Hz	0.01Hz	0.01Hz
OTHERS					
Efficiency	80% (Typical)	80% (Typical)	80% (Typical)	80% (Typical)	80% (Typical)
Protection	OPP, OLP, OTP, FAN Fail				
Temperature					
Operating	0 ~ 40°C	0 ~ 40°C	0 ~ 40°C	0 ~ 40°C	0 ~ 40°C
Storage	-40 ~ +85°C	-40 ~ +85°C	-40 ~ +85°C	-40 ~ +85°C	-40 ~ +85°C
Safety & EMC	CE (Include LVD and EMC Requirement)				
Dimension (WxHxD)	425x222x620 mm	425x222x620 mm	425x222x620 mm	546x845x700 mm	546x1065x700 mm

11.3.2 Power meter probe: 80i-110s AC/DC current clamp

The 80I-110s is compatible with any Fluke ScopeMeter Test Tool, Power Harmonics Analyzer, Oscilloscope, Multimeter, or other voltage measurement device that has the following features: BNC input connectors or if using a meter convert the banana plugs to a BNC connector using the adapter PM9081/001.

- Current Range: 0.1 to 100A DC or 0.1 to 70A AC
- Basic Accuracy (DC to 1kHz):
100mV/A setting: 50mA to 10A +/- 3% of reading + 50mA
10mV/A setting: 50mA to 40A +/- 4% of reading + 50mA
40A to 80A +/- 12% of reading + 50mA
80 to 100A +/- 15% of reading
- Output Signal: 10A range: 100mV/A | 100A range: 10mV/A
- Bandwidth: 1Hz to 20kHz
- Working Voltage: 600V AC rms
- Maximum Conductor Size: 11.8 mm (.46 inch) diameter

- Safety Rating: IEC 1010 and CSA-C22.2 No. 1010-1 Installation Category II, Working Voltage 600V