IEC 61850 AND IEC 62439 TECHNICAL INTEROPERABILITY TEST – BILBAO 2014

Author: SoC-e

Revised: AA

Version: 140718

Bilbao, July 18 2014

REVISION HISTORY

Ver .	Date	Responsible	Comments
140609	2014/06/09	AA	Initial version
140613	2014/06/13	AA	Logistics and Hotel Info
140617	2014/06/17	MI, AG	Test-Plan initial proposal
140625	2014/06/25	MI, AG	Revised according to new topology proposal without RSTP
140701	2014/07/01	MI	Added Flexibilis and Ingeteam to the pre-testing topologies
140707	2014/07/07	AA	Schedule
140709	2014/07/09	AG	Ping test added, minor corrections
140716	2014/07/16	AA	Interop results
100718	2014/07/16	MI	Some minor changes

Table 1 : Changes in the document

INDEX

FIGURE INDEX

TABLE INDEX

1 INTRODUCTION

The aim of this document is defining the technical test that will be run in the IEC 61850 AND IEC 62439 TECHNICAL INTEROPERABILITY TEST in BILBAO.

Additionally, this document can be used as a unique guide for the attendees due it include all the additional information related to shipment logistics, hotels and timetables.

1.1 UCAIug Booth Topology 2014

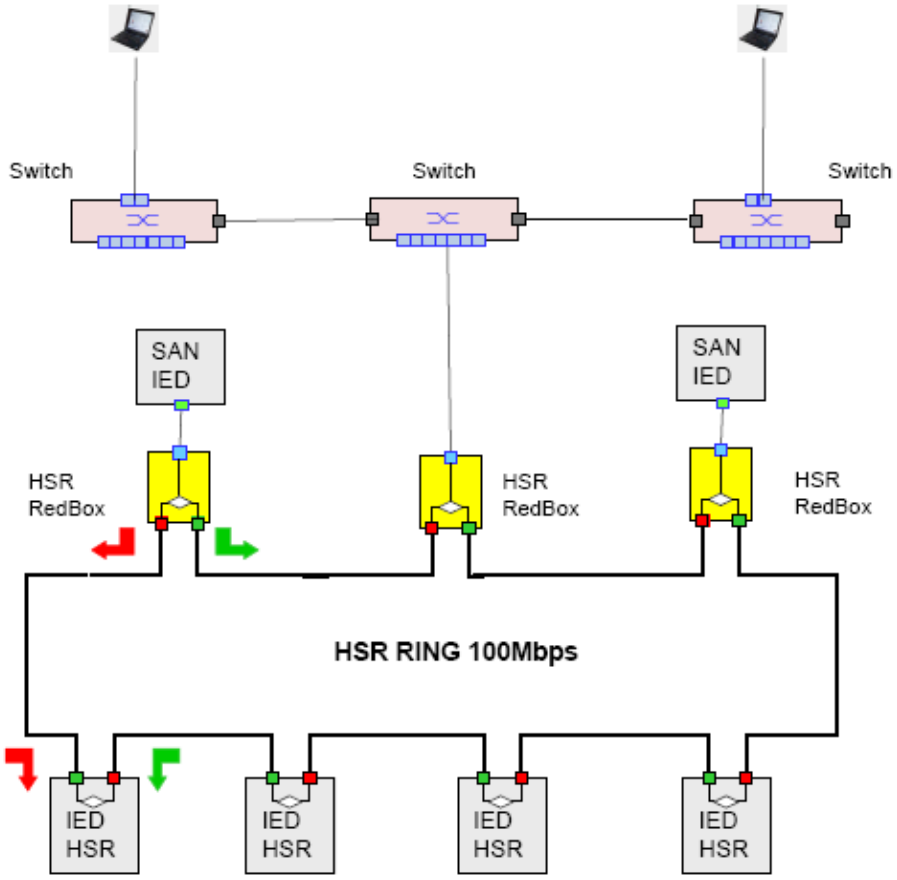


Figure 1: Conceptual Topology

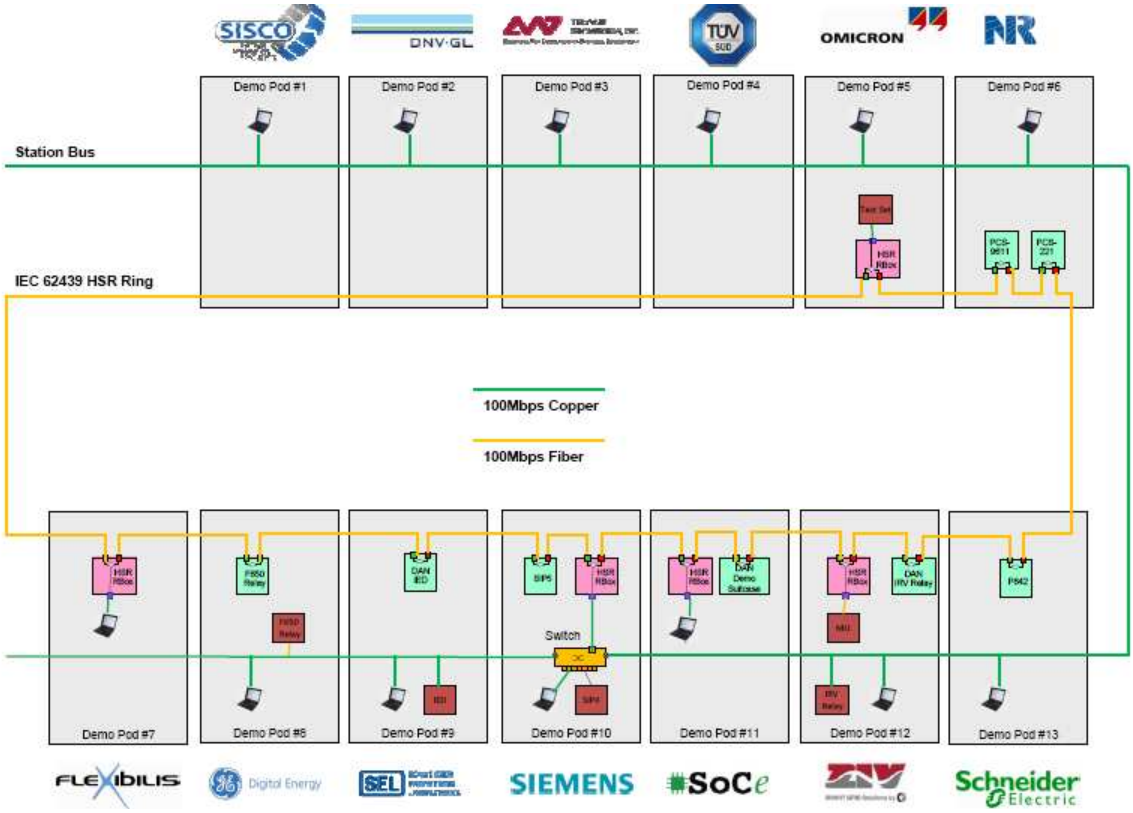
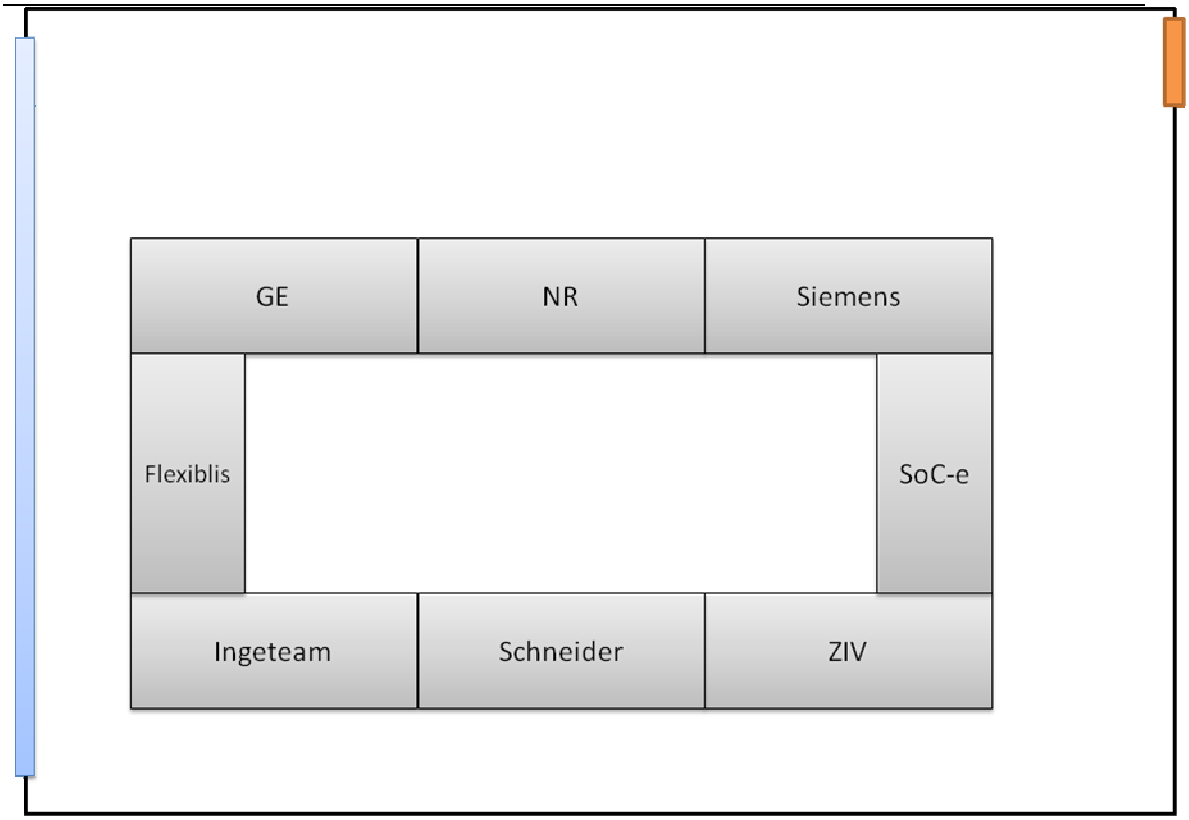


Figure 2: Network Topology

1.2 Test Premises Layout


GE
NR
Siemens
Flexiblis
SoC-e
Ingeteam
Schneider
ZIV

2 TEST PLAN

2.1 CIGRE2014 IEC62439/IEC61850 Pre-Testing

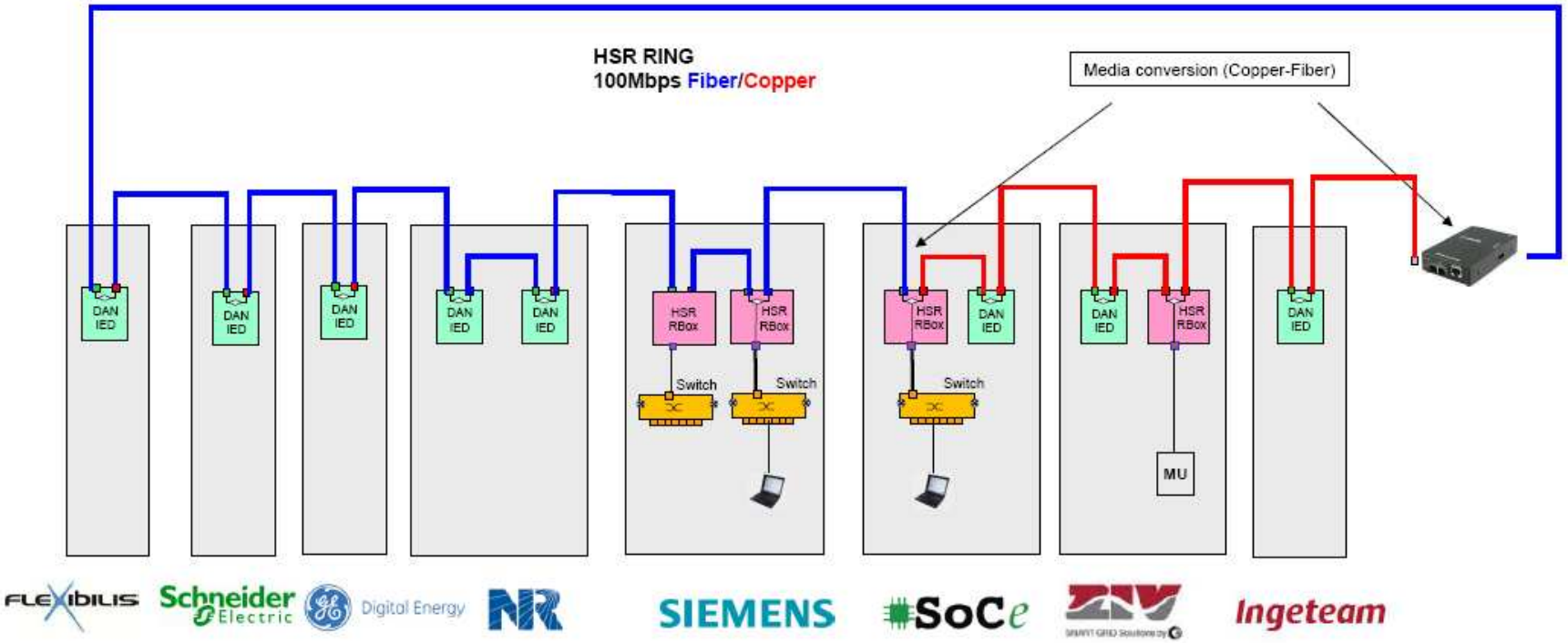


Figure 3: Pre-Testing. Topology I

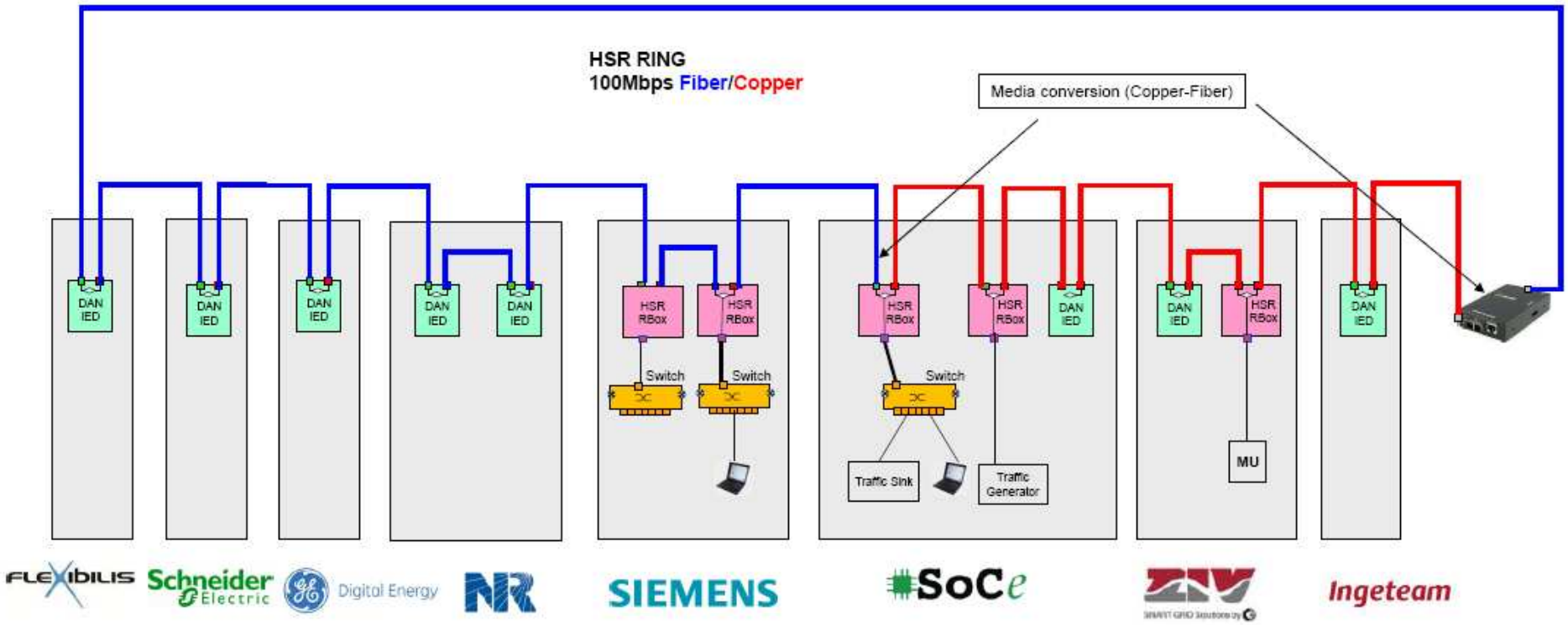


Figure 4: Pre-Testing. Topology II

2.1.1 Test 1A : Equipment physical interconnection

Test set-up

Network topology is shown in Figure 3.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5.

Test sequence

1. Check link status and autonegotiation results in every device.
2. Check Supervision frames received from every device.

Expected results

All devices are physically connected to their neighbours and send supervision frames.

Obtained results

11:00 The expected results were achieved. It was necessary to solve some minor issues in some IEDs that requested and specific order in the connection of port A and port B (probably using old revision of the standard).

2.1.2 Test 1B: Network testing

Test set-up

Network topology is shown in Figure 3.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5.

A ping flood is executed between two pingable devices without packet looses

11:30 Al equipment OK

Test sequence

1. Start ping flood between devices.
2. Break HSR ring.
3. Check ping req/res.
4. Close HSR ring.
5. Stop ping and check statistics.

Expected results

Every ping request is responded.

Obtained results

11:45 Regular ping (Windows) run. No problems detected. Both branches tested.

11:50 SIEMENS switch internal ping ping (Windows) run. No problems detected. Both branches tested.

12:30 Ping flood to Siemens laptop and switch and no packet lost.

Some flood pings to other cpus seem to collapse CPU and loose packet (because of the CPU not the network).

13:00-16:00 RFC2544 tests run on Flexibilis, Siemens and SoC-e RedBoxes with excellent results.

2.1.3 Test 1D: Running IEC61850 demo application (Breaker Failure)

One IED is set as initiator that initiates the event by pressing a frontal key. This will generate a signal of 250 ms internally. This signal is sent a Boolean in the GOOSE message. The rest of IEDs are subscribed to this event (GOOSE), and as a response each IED will send a GOOSE message. With the Wireshark we will see the behavior of all IEDs and the respective response times. It is optional for each device to show the initiator event by setting a led, closing a contact output, generating an internal event or whatever other mechanism.

The roles of each equipment on this test have been:

- GE 1: Initiator (send GOOSE)
- GE 2: GOOSE response. Optional: Setting a LED and contact output.
- INGETEAM: GOOSE response.
- ZIV: GOOSE response. Optional: Setting a LED.
- SCHNEIDER: GOOSE response. Optional: Setting a LED.
- NARI Relays: GOOSE response Optional: Setting a LED.

Expected results

When the initiator GOOSE message is sent, the relay must be activated and the remaining IEDs acknowledge with a GOOSE message each.

Obtained results

16:00 The setup runs correctly with the ring closed.

17:00 The setup runs correctly with the ring break through branch A (seen from initiator side)

(2014/07/16 10:00) The setup runs correctly with the ring break through branch A (seen from initiator side) and branch B. However some IEDs need to upgrade the firmware to complete the ring at CIGRE.

2.2 Optional Test 1: IEEE1588 with IEC62439 over CIGRE2014 Network Topology

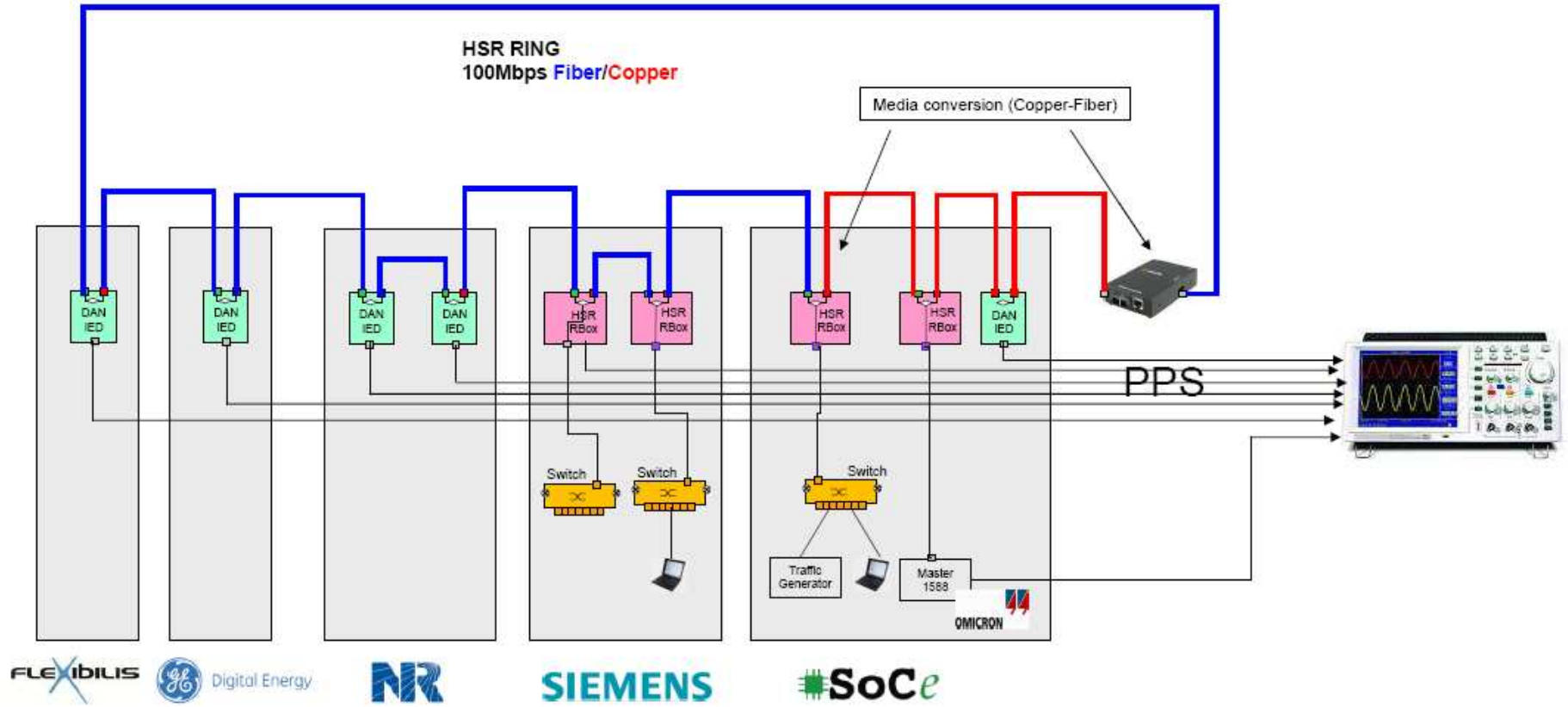


Figure 5: Pre-Testing. Topology III

2.2.1 Optional Test 1A. Basic Test

Test set-up

Network topology is shown in Figure 5. GrandMaster is connected to a single network and this through a Transparent Clock to the HSR ring.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet
- Multicast
- P2P delay calculation mechanism
- 2-step
- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.

Expected results

All slaves should be synchronized below 1us.

Obtained results

12:00 The IEEE1588 slaves connected to the network have been synchronized below one microsecond.

It has been detected a constant offset of approx 450 ns in all the nodes generated by the non-1588 aware media converter.

2.2.2 Optional Test 1B. Open and close HSR ring

Test set-up

Network topology is shown in Figure 5. GrandMaster is connected to RSTP network and this through a StateLess Transparent Clock to the HSR ring.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet

- Multicast
- P2P delay calculation mechanism
- 2-step
- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.
3. Break HSR ring.
4. Check synchronization.
5. Close HSR ring.
6. Check synchronization.

Expected results

All slaves should be synchronized below 1us in steps 2, 4 and 6.

Obtained results

12:45 The HSR ring has been broken in two different sections, and the nodes have maintained the synchronization

13:00 Additional traffic has been injected into the ring using ALBEDO Ether.sync equipment showing a good behavior up to 80% with 64 bytes and 1518 bytes in all the nodes. Some nodes missed the sync at 90% maximum throughput with 1518 bytes frames length.

2.2.3 Optional Test 1C. Network impairments.

Test set-up

Network topology is shown in Figure 5. GrandMaster is connected to RSTP network and this through a Transparent Clock to the HSR ring. Traffic generator is connected to the HSR ring through a RedBox.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet
- Multicast
- P2P delay calculation mechanism
- 2-step
- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Traffic load description

- Multicast
- Packet length RFC 2544

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.
3. Inject traffic by steps (10%, 20%, 40%, 60%, 80%, 90%).
4. Check synchronization in each step.

Expected results

All slaves should be synchronized below 1us during all test duration.

Extra impairment tests

Using a net impairment equipment inserted in HSR ring, several impairments could be forced such as packet dropping, bit error, duplicated packets or packet delay variation. These tests can be determined in situ under the requirements of the attendees.

Obtained Results

Not implemented.

2.3 Optional Test 2: 1GE HSR IEEE1588 P2P

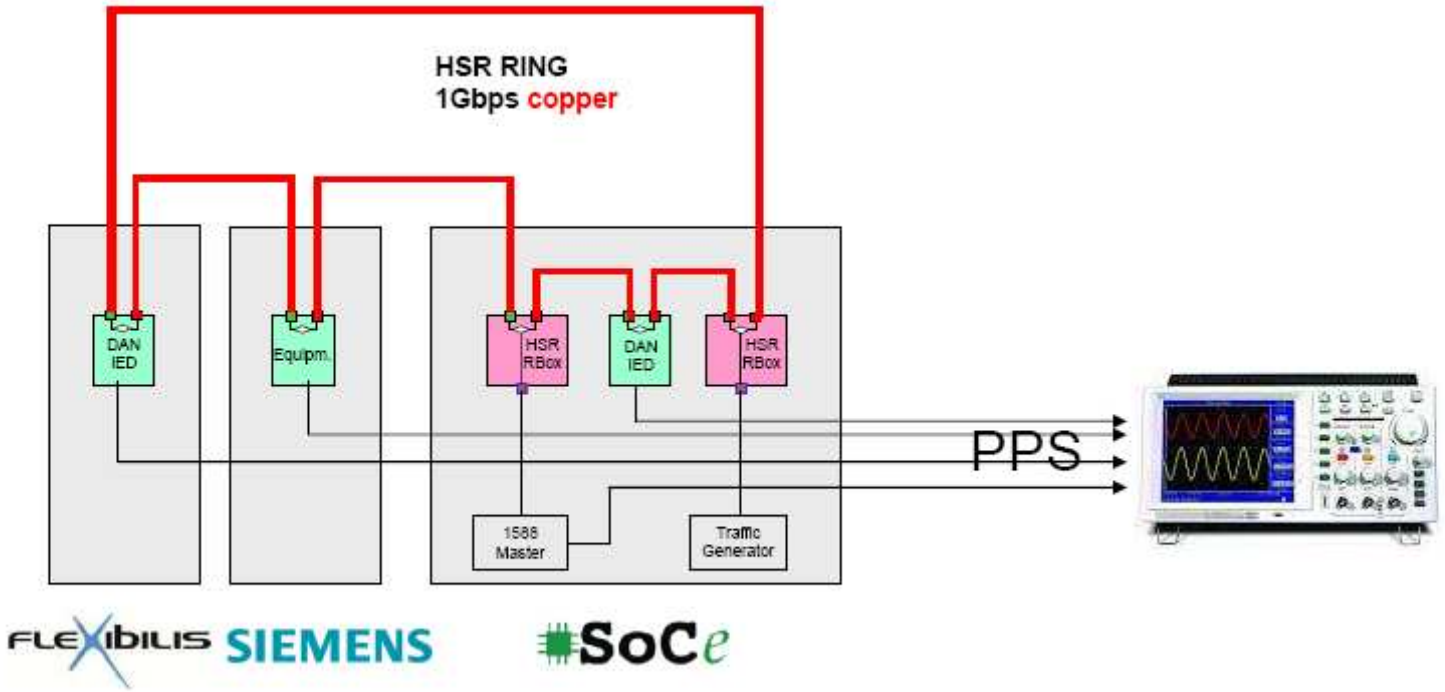


Figure 6: Pre-Testing. Topology IV

2.3.1 Optional Test 2A. Basic Test

Test set-up

Network topology is shown in Figure 6. GrandMaster is connected through a StateLess Transparent Clock to the HSR ring.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet
- Multicast
- P2P delay calculation mechanism
- 2-step
- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.

Expected results

All slaves should be synchronized below 1us.

2.3.2 Optional Test 2B. Open and close RSTP and HSR rings

Test set-up

Network topology is shown in Figure 6. GrandMaster is connected through a Transparent Clock to the HSR ring.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet
- Multicast
- P2P delay calculation mechanism
- 2-step

- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.
3. Break HSR ring.
4. Check synchronization.
5. Close HSR ring.
6. Check synchronization.

Expected results

All slaves should be synchronized below 1us in steps 2, 4, and 6.

2.3.3 Optional Test 2C. Network impairments.

Test set-up

Network topology is shown in Figure 6. GrandMaster is connected through a StateLess Transparent Clock to the HSR ring.

Redundancy in HSR ring is according to IEC 62439-3 Chap 5. PTP configuration used is Utility Profile IEC 62439-3/CDV:2014 Annex B

- Layer 2 Ethernet
- Multicast
- P2P delay calculation mechanism
- 2-step
- PTP management and signaling disabled
- 1 announce/s, 1 sync/s, 1 pdelay_req/s

Traffic description

- Multicast
- Packet length RFC 2544

Test sequence

1. Switch all slaves on.
2. Check that all slaves are synchronized to the GM using a PPS signal.
3. Inject traffic by steps (10%, 20%, 40%, 60%, 80%, 90%).
4. Check synchronization in each step.

Expected results

All slaves should be synchronized below 1us during all test duration.

Obtained results

16:00 An 1GE HSR ring was set with 1 Siemens Redbox, 3 Flexibilis nodes and 3 SoC-e nodes, all of them IEEE 1588-aware and implementing P2P mechanism. One IEEE 1588 Master was connected to SoC-e Redbox. All the nodes synchronized to the master below 500 ns.

16:30 The ring was broken in different sections in order to analyze the behavior of the redundant IEEE 1588 Synchronization and it was show how the nodes were capable of changing the master used for synchronization. This change was automatically performed when a branch failed or when the priority of the available masters in the networks changed as well.

16:45 Heavy traffic load was injected in the ring and all the nodes showed a stable behavior.

Extra impairment tests

Using a net impairment equipment inserted in HSR ring, several impairments could be forced such as packet dropping, bit error, duplicated packets or packet delay variation. These tests can be determined in situ under the requirements of the attendees.

Obtained Results

Not implemented.

3 TEST SCHEDULE / TIMETABLE

Monday, 14th of July	**Test**	**Comments**
14-19h	None	Room open for equipments mounting
19h-	None	Room is locked
Tuesday, 15th of July	**Test**	**Comments**
8:30-9:30h	None	Room open for equipments mounting
9:30h-11:00h	Test 1A : Equipment physical interconnection	
11:00-11:15h	None	Coffee Break
11:15-13:15h	Test 1B: Network testing	
13:15-14:15	Lunch	Sandwiches and refreshments available in the Interop. Location
14:15-17:00	Test 1D: Running IEC61850 demo application	
17:00-		Room is locked
Wednesday, 16th of July	**Test**	**Comments**
9:00-10:00h	Optional Test 1A. Basic Test	
10:00-11:00	Optional Test 1B. Open and close HSR ring	
11:00-11:15h	None	Coffee Break
11:15-13:15h	Test 1C: Network impaiments	

13:15-14:15	Lunch	Sandwiches and refreshments available in the Interop. Location
14:15-17:00	Optional Test 2: 1GE HSR IEEE1588 P2P	Note: During this timeslot, Master students can visit the Interop. Room in an schedules sequence.
17:00-		Room is locked and all the equipment should be removed from the room (see section “logistics”)

4 LOGISTICS AND OTHER ADDITIONAL INFORMATION

4.1 INTEROPERABILITY PREMISES LOCATION

FACULTY OF ENGINEERING – UPV/EHU

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA DE BILBAO

http://www.ingeniaritza-bilbao.ehu.es/p224-homeen/en/

Alameda Urquijo s/n. 48013 - Bilbao

Tfno: 94 601 4024

Fax: 94 601 4296

GPS: 43º26'27.01"N 2º94'77.05"O

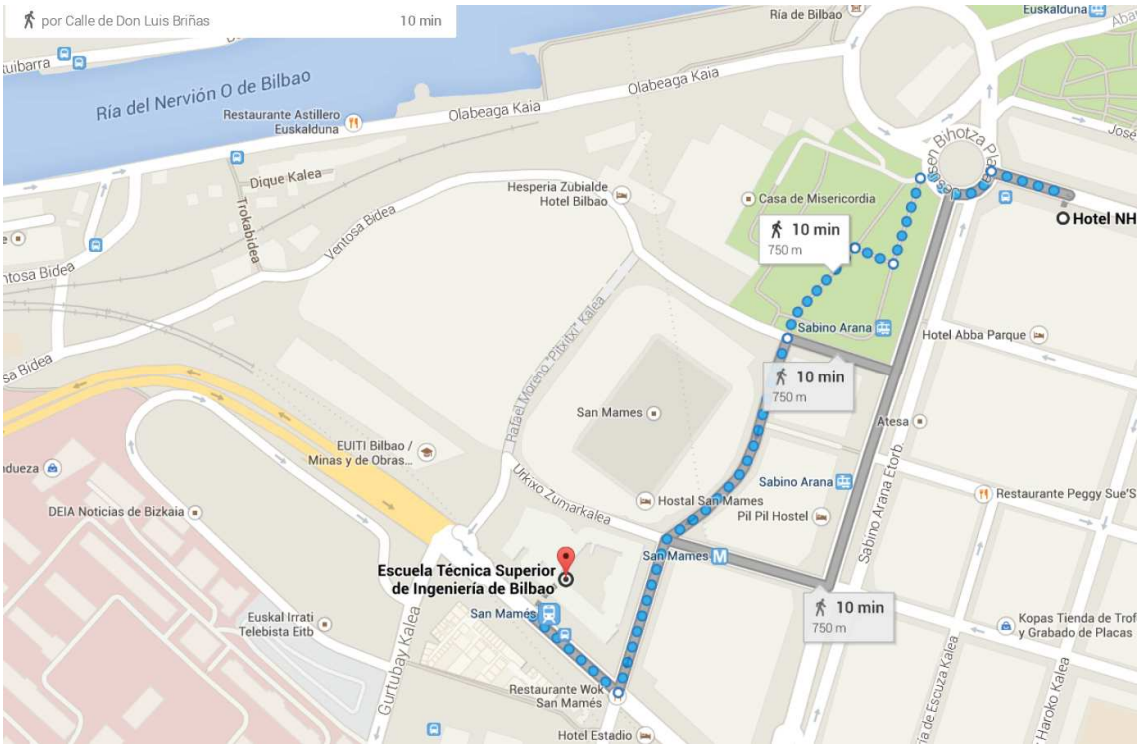


Figure 7: Location of the Faculty of Engineering and the NH Hotel

Interoperability Tests room information:

- Name: P1G1A
- Location: G building
- Recommended Entry: Luis Briñas Street (closer o the Metro elevator, see next MAP)

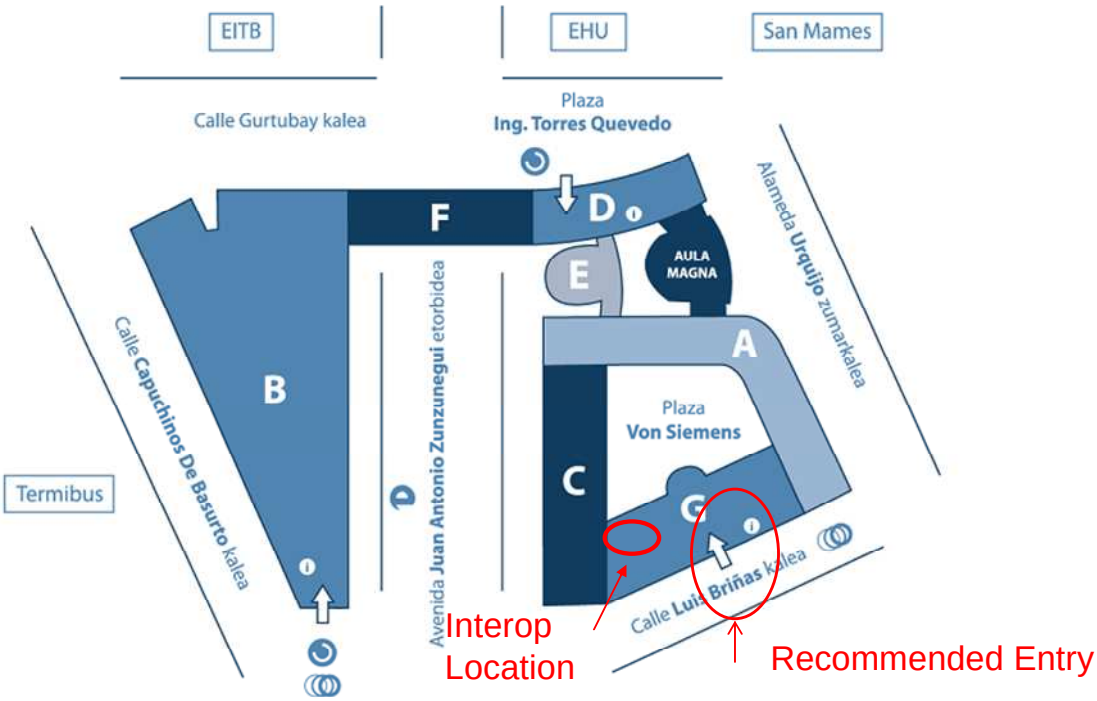


Figure 8: Interop. premises location

4.2 SHIPMENTS LOGISTICS

4.2.1 Shipment address

All the packages for the Interop in Bilbao, must be delivered to the following address:

Att: D. LUIS URIA (Laboratorio de Tecnología Electrónica)

ESCUELA TECNICA SUPERIOR DE INGENIERIA (FACULTY OF ENGINEERING UPV/EHU)
PLAZA ING. TORRES QUEVEDO, 1
48013 BILBAO
SPAIN

Telephone: +34 644064541

4.2.2 Dates for packages collect/delivery

All the packages sent to this event will be stored in a specific premise in the Faculty of Engineering of Bilbao. The interop event will be help in the same Faculty.

The dates opened to collect packages are:
From **July 7th to July 15th**

The transport companies can collect the packages at the same address in the following dates:
From **July 16th to July 23rd**

(Except Saturdays and Sundays)

If anyone requires any special arrangement regarding the logistics, please contact aitzol.zuloaga@ehu.es

4.3 HOTEL INFORMATION

NH COLLECTION VILLA DE BILBAO HOTEL

This is the suggested first option.

Address: Gran Vía, 87 | 48011 Bilbao | SPAIN
Phone: +34 94 441 60 00, ge.dearrese@nh-hotels.com, www.nh-hotels.com
Hotel class: 4 stars

Prices per room and night (reservation till 2014/7/2):

In: 14/07/2014

Out: 16/07/2014

Single room: 82 euros

Double room: 93 euros

Buffet breakfast: included

Value-addeed tax (VAT) Not included: 10%

To book phone or mail (nhvilladebilbao@nh-hotels.com) and give the reference "IEC 61850 AND IEC 62439 TECHNICAL INTEROPERABILITY TEST".

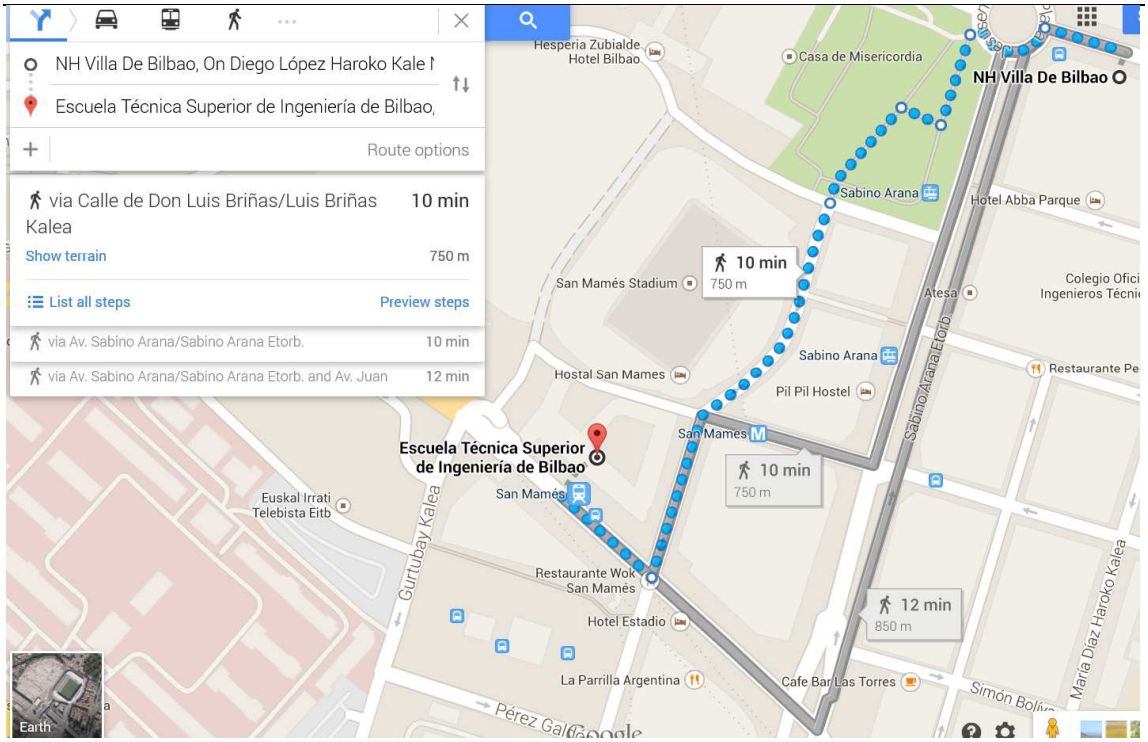


Figure 9: NH Bilbao Hotel Location

HESPERIA ZUBIALDE HOTEL

Address: Camino de la Ventosa, 34, 48013 BILBAO, SPAIN
Phone: +34 94 400 81 00, hotel@hesperia-zubialde.com, www.nh-hotels.com
Hotel class: 4 stars

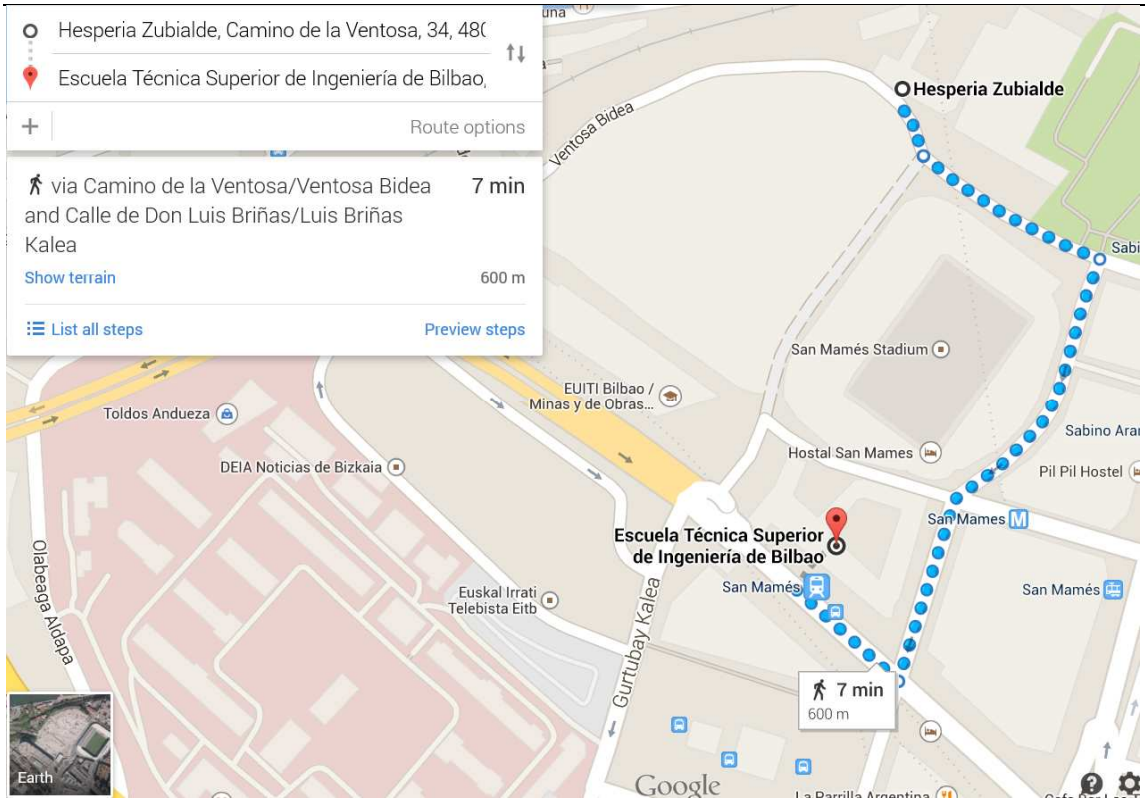


Figure 10: Hesperia Hotel Location

ERCILLA HOTEL

Address: Calle de Ercilla, 37-39, 48011 Bilbao, Vizcaya
Phone: +34 944 70 57 00, http://www.hotusa.com/hotels/spain/vizcaya-bilbao/bilbao/hotel-ercilla.html
Hotel class: 4 stars

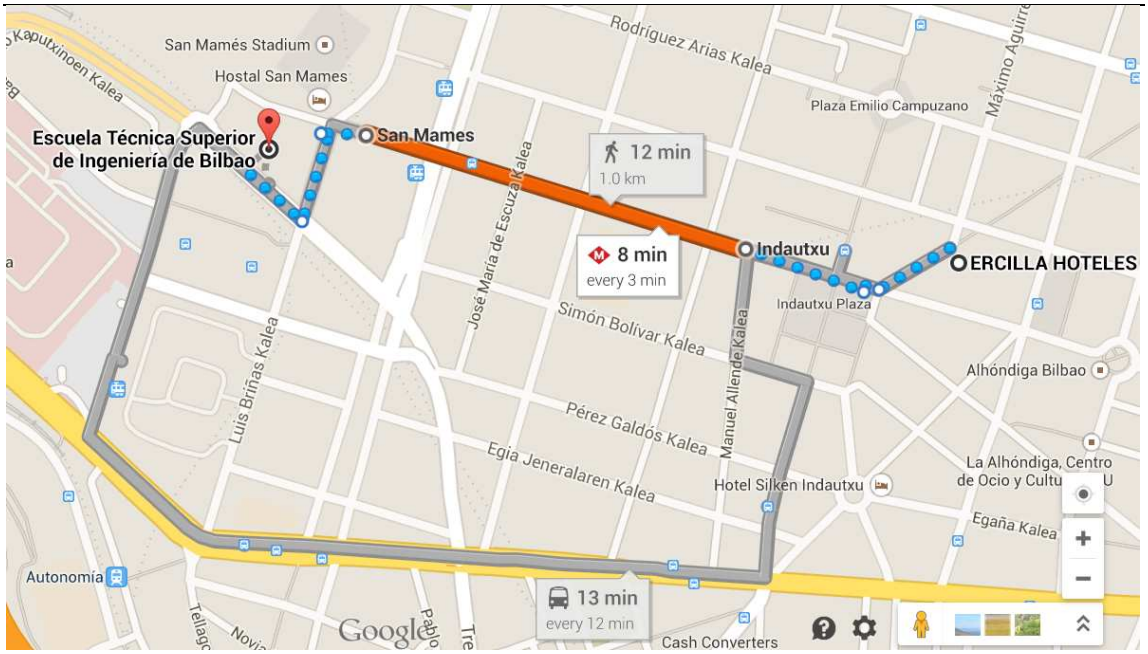


Figure 11: Ercilla Hotel Location