



GN3plus Open Call: Technical Annex A – GÉANT Dark Fibre Testbed

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THE SEVENTH FRAMEWORK PROGRAMME

The Seventh Framework Programme focuses on Community activities in the field of research, technological development and demonstration (RTD) for the period 2007 to 2013

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0 Executive Summary

This technical annex is provided in support of the GN3plus Open Call. It provides a technical description of the GÉANT dark fibre testbed to support submissions to the following Open Call topics:

- Theme 1: Innovative Uses of GÉANT Network Facilities.
 - Topic 1: Photonic Level Access to Long-Haul Dark Fibre.
 - Topic 4: Terabit Transmission Trial.

The aim of this document is to provide sufficient technical detail to allow proposers to put together a technical proposal for these topics.

The GÉANT dark fibre testbed is made up of dark fibre (DF) that has become available due to the recent GÉANT network migration. Five DF routes are available from October 2013 and can be used until contracts expire at the end of Q2 2015. The DF routes are:

- London–Paris.
- Frankfurt–Geneva.
- Amsterdam–Frankfurt.
- Amsterdam–Brussels.
- Milan–Finkenstein–Vienna.

1 Access to GÉANT Dark Fibre

Applications can be made to access GÉANT dark fibre as part of an Open Call proposal. The following access options are available:

Option 1: Access to the dark fibre only

In this case the proposer may request access to the dark fibre for the purpose of testing novel optical equipment. In this case the proposer will use their own in-line optical amplifier equipment to be installed at each amplifier site. The cost of this optical amplifier equipment may be partially funded either via the Open Call budget or by the proposer. It is likely that funding of in-line optical amplifiers from the Open-Call budget would only be considered where novel amplification systems are proposed; otherwise proposers should expect to provide their own amplifiers or use Option 2 below. The cost of pre-existing hut space and power is included as part of the DF testbed facility and does not need to be funded out of the Open Call budget or by the proposer. If additional power or space is required, these requirements need to be identified in the proposal and negotiated with DANTE. The costs of these extra facilities should be borne by the proposer. Awardees are expected to be responsible for their own installation and maintenance of any in-line optical amplifier equipment and any other equipment that the Awardee has installed.

Option 2: Access to dark fibre and existing Alcatel-Lucent in-line optical amplifiers

In this case the proposer can use the Alcatel-Lucent optical amplifier equipment available in each of the amplifier sites. The cost of the Alcatel-Lucent amplifier equipment, hut space and power is included as part of the DF testbed facility and does not need to be funded out of the Open Call budget or by the proposer.

Notes (applicable to both options):

1. Any request for new equipment to be installed on the dark fibre must be agreed in advance with DANTE. Where DANTE deems the installation to be inappropriate or to pose a risk to the facility (the hut or the fibre), DANTE reserves the right to decline the request.
2. The Alcatel-Lucent amplifiers are manageable in-line using Alcatel-Lucent's craft terminal software. This management system operates over an in-band optical supervisory channel.
3. Maintenance arrangements for the Alcatel-Lucent equipment in the DF testbed will not be production grade. However, DANTE will endeavour to deliver a best-effort maintenance service. DANTE does not have an ongoing maintenance contract with Alcatel-Lucent, so repair times cannot be guaranteed. However, DANTE will hold spares.

4. Where it is technically feasible and desirable, optical spectrum sharing may be coordinated by DANTE to allow multiple users to share the same fibre. In this case the proposer will be given access to part of the optical spectrum for the purpose of performing experiments.
5. In each city the network demarcation points will be within the GÉANT Point of Presence (PoP) in that city. Extensions to other locations in or near that city will be the responsibility of the successful proposers.

2 Fibre Overview

A summary of the five dark fibre routes available for use as part of the DF testbed are shown in Table 2.1 below.

Route	Length (km)	Long-haul fibre type	Metro fibre type	Total loss	Number of amplifier sites (huts)
London–Paris	673 km	G.655	10km of G.652	170dB	9
Frankfurt–Geneva	749 km	G.655	32.7km of G.652	165dB	8
Amsterdam–Frankfurt	665 km	G.655	37km of G.652	157dB	8
Amsterdam–Brussels	290 km	G.655	14km of G.652	70dB	3
Milan–Finkenstein–Vienna	643 km+ 462 km	G.655	13km+29km of G.652	157dB+ 98dB	9+6

Table 2.1: Routes for DF testbed

Further details are provided in Section 5.

3 Equipment Available

The following equipment is available to use in the dark fibre testbed.

3.1 Hut

Each hut contains:

- An Alcatel-Lucent 2-stage in-line optical amplifier for the LM1626 transmission system, designed for transmission of NRZ modulated 10G wavelengths. All the amplifiers are EDFA only; no RAMAN amplifiers are available in any of the huts.
- Two spools of dispersion compensation fibre (one per fibre). These are selected to match the dispersion of the optical line and are connected between amplifier stages.

Please contact opencalls@geant.net if you would like further details.

3.2 Line-End Equipment

Each end PoP includes Alcatel-Lucent LM1626 line-terminating equipment. This should be used for:

- Management of the in-line amplifiers via the optical supervisory channel.
- ITU-T channel filters. (Not all bands will be present. Details are available on request.)

A limited number of 10G transponders with a number of framing types are available at no cost to the proposer. Please contact DANTE if you would like more information about these.

3.3 Management

An Alcatel-Lucent craft terminal can be made available for management of the amplifiers if needed.

4 Housing and Power

Pre-existing and ongoing dark fibre leases include the following equipment in each hut available for researchers at no additional charge. Note that if multiple users are awarded access to a dark fibre section, then these resources may need to be shared between projects.

- A half-height 21 inch ETSI rack with a 300 mm x 600 mm footprint. Contains:
 - An Alcatel-Lucent amplifier shelf1 of 11 RU height.
 - Dispersion compensation fibre modules.
- 2 x 10A 48VDC feed to each rack.

Notes:

1. Work on any equipment on site will normally be performed by DANTE personnel on behalf of the project. In some situations, researchers may have access to sites and equipment as needed. However, this will be escorted access only. Such access must be arranged in advance with the DANTE NOC and is subject to approval by both DANTE and DANTE's suppliers.
2. There is no out-of-band management to the amplifier huts. If this is needed, it should be provided in-band by the equipment installed by the researchers.

5 Dark Fibre Route Details

5.1 London–Paris Route Details

General Fibre Provider: Level 3

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
			Coeff. ps/nm.km	CD ps		
PoP-Spl01	London (Harbour Exchange)-London (Braham Street)	3.0	16.3	97.8	G.652	6.0
Spl01-Hut 1	London (Braham Street)-London (Goswell Road)	4.0	6.0	24.0	G.655 (LEAF)	4.0
Hut 1 - Hut 2	London (Goswell Road)-Paddock Wood	23.9	6.0	521.4	G.655 (LEAF)	86.9
Hut 2 - Hut 3	Paddock Wood-Folkestone	18.0	6.0	451.4	G.655 (LEAF)	75.2
Hut 3 - Hut 4	Folkestone-Gravelines	23.2	6.0	564.5	G.655 (LEAF)	94.1
Hut 4 - Hut 5	Gravelines-Lille	19.4	6.0	501.2	G.655 (LEAF)	83.5
Hut 5 - Hut 6	Lille-Bois Bernard	15.8	6.0	396.5	G.655 (LEAF)	66.1
Hut 6 - Hut 7	Bois Bernard-Albert	12.0	6.0	309.7	G.655 (LEAF)	51.6
Hut 7 - Hut 8	Albert-Beavais	21.0	6.0	568.8	G.655 (LEAF)	94.8
Hut 8 - Hut 9	Beauvais-Paris GWY	21.2	6.0	523.7	G.655 (LEAF)	87.3
Hut 9 - ODF	Paris GWY-Paris Interxion	8.2	16.3	378.9	G.652(SMF-28)	23.2
Total Loss (dB)		169.7	TOTAL CD (ps)	4337.9	TOTAL Distance (km)	672.8

Table 5.1: London–Paris route details

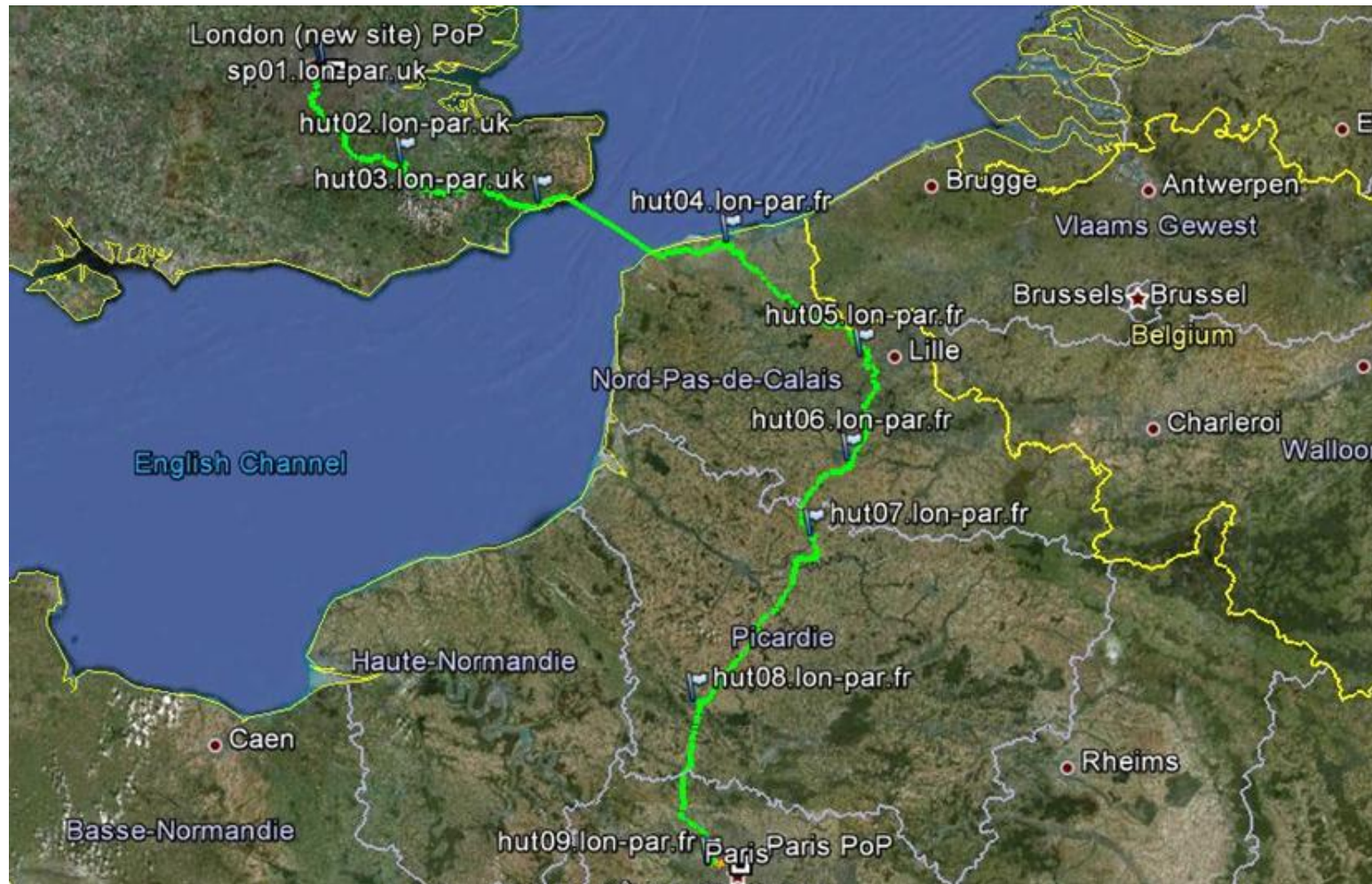


Figure 5.1: London–Paris route details

5.2 Frankfurt–Geneva Route Details

General Fibre Provider: Colt

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
			Coeff. ps/nm.km	CD ps		
PoP-Spl01	Frankfurt (Interexion)-DE FRA 01	┐	┐	┐	G.652 (Pirelli Rapier)	┐
Spl01-Spl02	DE FRA01-DE1.0				G.652 (Pirelli Rapier)	
Spl02-Hut01	DE1.0-DE1.1	23.5	6.9	717.9	G.655 (Corning Leaf)	103.4
Hut01-Hut02	DE1.1-DE1.2	20.2	4.2	395.9	G.655 (Corning Leaf)	93.7
Hut02-Hut03	DE1.2-DE8.1	13.4	4.1	250.9	G.655 (Corning Leaf)	60.5
Hut03-Hut04	DE8.1-FR9.1	13.9	4.2	255.7	G.655 (Corning Leaf)	60.8
Hut04-Hut05	FR9.1-FR24.5	21.8	4.3	431.4	G.655 (Corning Leaf)	100.7
Hut05-Hut06	FR24.5-CH24.4	16.8	4.2	307.5	G.655 (Corning Leaf)	73.2
Hut06-Spl03	CH24.4-CH24.3	┐	┐	┐	G.655 (Corning Leaf)	┐
Spl03-Hut07	CH24.3-CH24.2	26.1	4.3	530.7	G.655 (Corning Leaf)	122.1
Hut07-Hut08	CH24.2-CH24.1	14.2	4.3	285.1	G.655 (Corning Leaf)	65.6
Hut08-PoP	CH24.1-GEN	15.0		429.0	G.655 (Corning Leaf)	68.6
	Total Loss (dB)	164.8	TOTAL CD (ps)	3604.2	TOTAL Distance (km)	748.7

Table 5.2: Frankfurt–Geneva route details

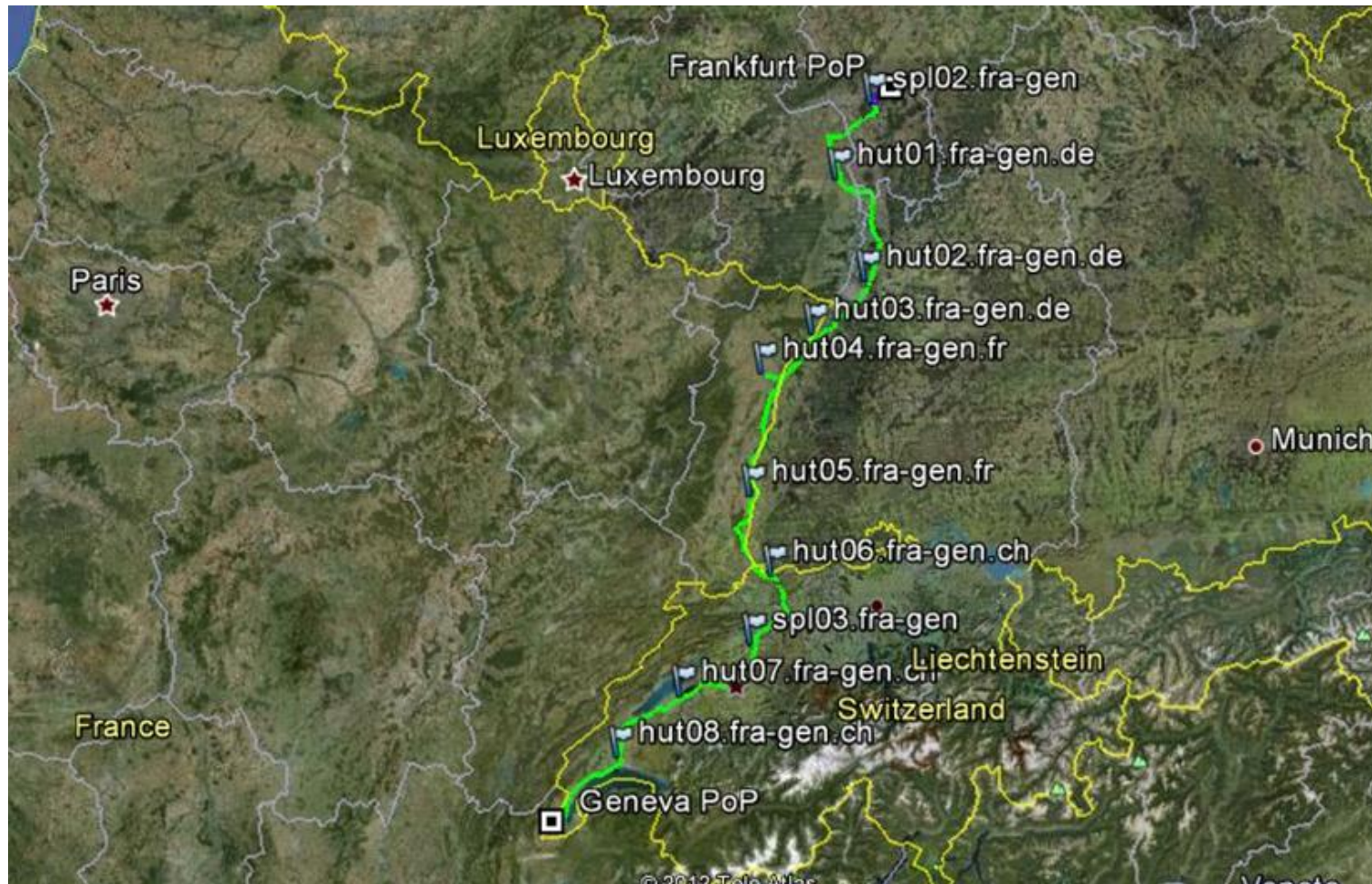


Figure 5.2: Frankfurt–Geneva route details

5.3 Amsterdam–Frankfurt Route Details

General Fibre Provider: Level3

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
			Coeff. ps/nm.km	CD ps		
PoP-Hut01	Amsterdam (SARA)-Amsterdam(Stekkenbergweg)	6.2	16.3	391.2	G.652	24.0
Hut01 - Hut02	Amsterdam(Stekkenbergweg)-Ede	23.4	6.0	510.9	G.655 (ELEAF)	85.2
Hut02 - Hut03	Ede-Kevelaer	24.8	6.0	654.4	G.655 (ELEAF)	109.1
Hut03 - Hut04	Kevelaer-Dusseldorf	23.3	6.0	565.0	G.655 (ELEAF)	94.2
Hut04 - Hut05	Dusseldorf-Bornheim	20.7	6.0	444.3	G.655 (ELEAF)	74.1
Hut05 - Hut06	Bornheim-Mayen	17.9	6.0	514.8	G.655 (ELEAF)	85.8
Hut06 - Hut07	Mayen-Stromberg	15.8	6.0	455.8	G.655 (ELEAF)	76.0
Hut07 - Hut08	Stromberg-Frankfurt (Russelheimerstrasse)	21.0	6.0	619.7	G.655 (ELEAF)	103.3
Hut08-PoP	Frankfurt(Russelheimerstrasse)-Frankfurt(InterXion)	4.2	16.3	215.6	G.652	13.2
Total Loss (dB)		157.3	TOTAL CD (ps)	4371.8	TOTAL Distance (km)	664.7

Table 5.3: Amsterdam–Frankfurt route details

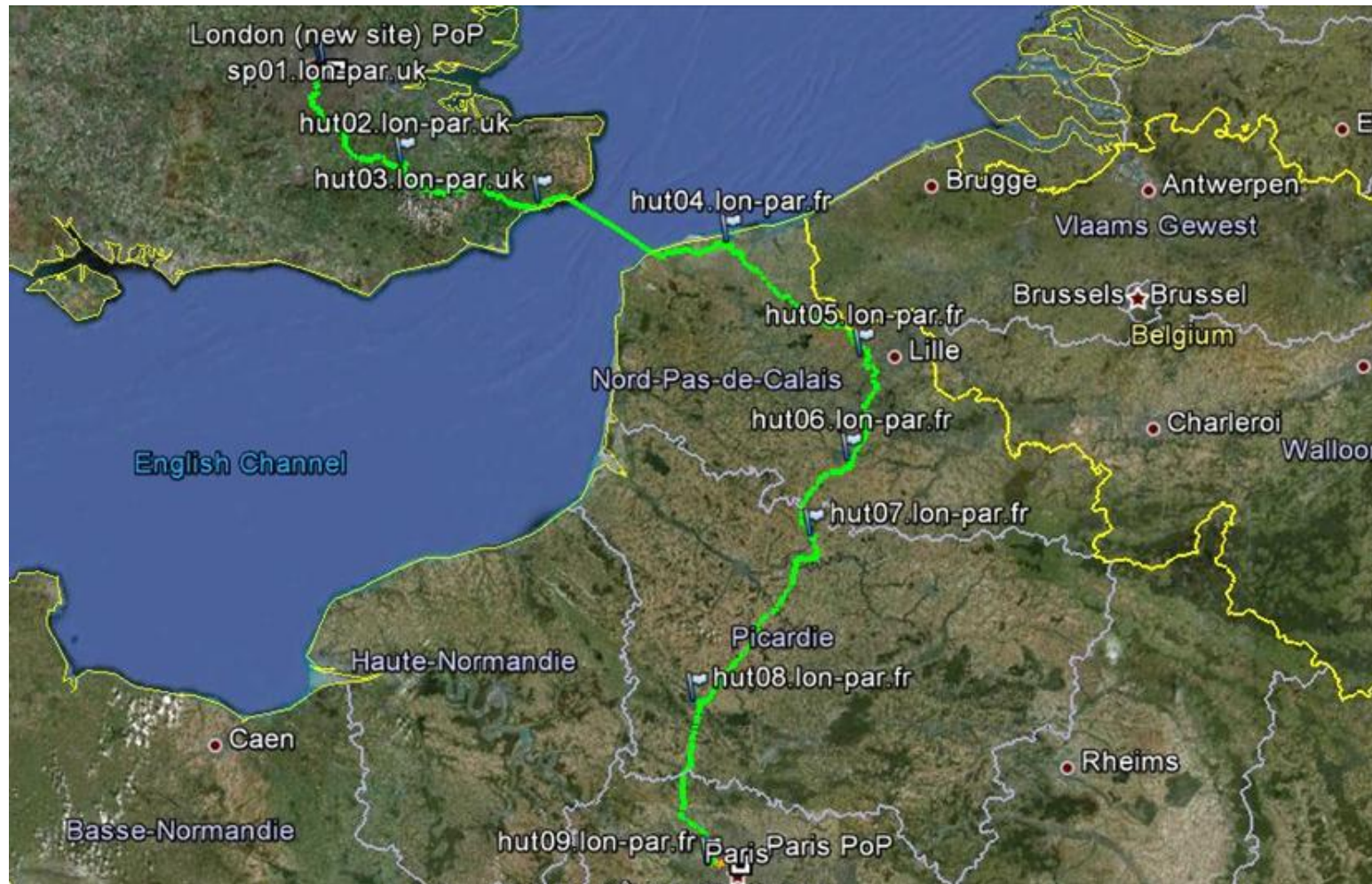


Figure 5.3: Amsterdam–Frankfurt route details

5.4 Amsterdam–Brussels Route Details

General Fibre Provider: Level3

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
			Coeff. ps/nm.km	CD ps		
PoP - Hut 3	Brussels-Kapellen	19.0	6.0	494.0	G.655	82.3
Hut 3 - Hut 2	Kapellen-Rotterdam	19.2	6.0	508.8	G.655	84.8
Hut 2 - Hut 1	Rotterdam-Amsterdam(GWY)	27.7	6.0	652.8	G.655	108.8
Hut 1 - PoP	Amsterdam(GWY)-Amsterdam(Sara)	4.4	16.3	227.5	G.652	14.0
	Total Loss (dB)	70.3	TOTAL CD (ps)	1883.2	TOTAL Distance (km)	289.9

Table 5.4: Amsterdam–Brussels route details



Figure 5.4: Amsterdam–Brussels route details

5.5 Milan–Finkenstein–Vienna Route Details

General Fibre Provider: Interroute

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
			Coeff. ps/nm.km	CD ps		
Pop-Hut06	Vienna(InterXion)-Vienna(Interroute)	7.3	16.3	474.0	G.652(Siemens, Corning)	29.1
Hut06-Hut05	Vienna(Interroute)-Wiener Neusiad	9.6	6.0	277.8	G.655 (Corning Leaf)	46.3
Hut05-Hut04	Wiener Neusiad-Hartberg	17.9	6.0	517.1	G.655 (Corning Leaf)	86.2
Hut04-Hut03	Hartberg-Graz	14.3	6.0	406.4	G.655 (Corning Leaf)	67.7
Hut03-Hut02	Graz-Sankt Oswald ob Eibiswald	16.1	6.0	464.2	G.655 (Corning Leaf)	77.4
Hut02-Hut01	Sankt Oswald ob Eibiswald-Grafenstein	17.1	6.0	495.6	G.655 (Corning Leaf)	82.6
Hut01-PoP	Grafenstein-Finkenstein	15.1	6.0	436.1	G.655 (Corning Leaf)	72.7
Total Loss (dB)		97.5	TOTAL CD (ps)	3071.3	TOTAL Distance (km)	462.0

Table 5.5: Finkenstein–Vienna route details

General Fibre Provider: Interroute

Transmission Sections	Named Transmission Sections	Loss (dB)	Chromatic Dispersion		Fibre Type	Distance (km)
PoP-Hut01	Finkenstein-Pontebba	11.7	6.0	283.4	G.655 (Corning Leaf)	47.2
Hut01-Hut02	Pontebba-Udine	18.5	6.0	298.9	G.655 (Corning Leaf)	49.8
Hut02-Hut03	Udine-Latisana	16.6	6.0	464.1	G.655 (Corning Leaf)	77.3
Hut03-Hut04	Latisana-Venice	16.8	6.0	465.2	G.655 (Corning Leaf)	77.5
Hut04-Hut05	Venice-Carmignano di Brenta	16.9	6.0	409.8	G.655 (Corning Leaf)	68.3
Hut05-Hut06	Carmignano di Brenta-Verona	17.2	6.0	427.0	G.655 (Corning Leaf)	71.2
Hut06-Hut07	Verona-Rezzato	13.4	6.0	361.2	G.655 (Corning Leaf)	60.2
Hut07-Hut08	Rezzato-Mozzanica	13.3	6.0	357.5	G.655 (Corning Leaf)	59.6
Hut08-Hut09	Mozzanica-Milan(Via Brianza)	12.3	6.0	330.5	G.655 (Corning Leaf)	55.1
Hut09-Spl01	Milan (Via Brianza)-Milan(via Caldera)	19.8	6.0	382.1	G.655 (Corning Leaf)	63.7
Spl01-Pop	Milan(via Caldera)- Milan (GEANT2)	┘	16.3	211.9	G.652 (Corning)	13.0
Total Loss (dB)		156.5	TOTAL CD (ps)	3991.7	TOTAL Distance (km)	643.0

Table 5.6: Milan–Finkenstein route details

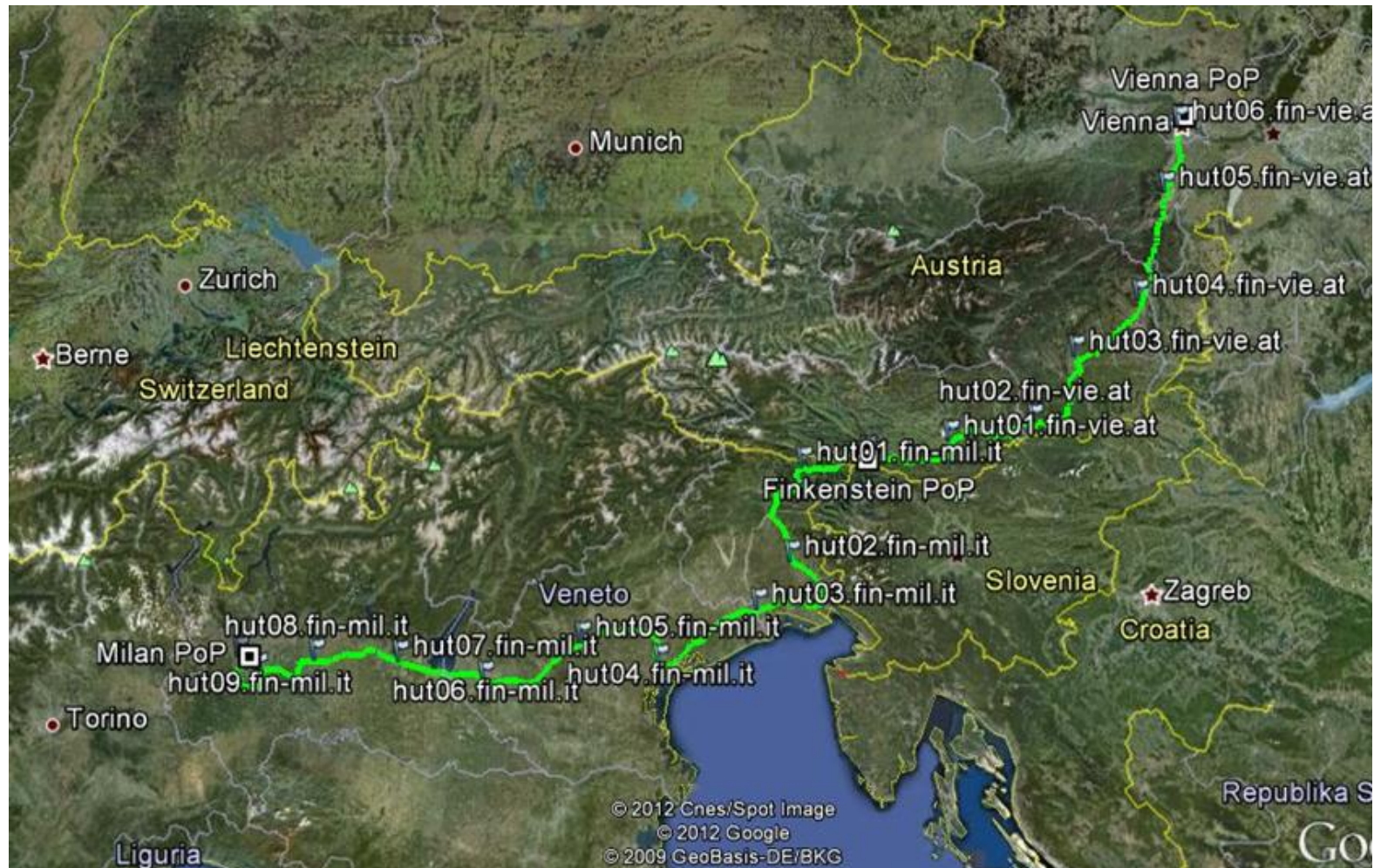


Figure 5.5: Milan–Finkenstein–Vienna route details

6 PoP Addresses

PoP	Address	PoP	Address
Finkenstein	Corner of Rosental Bundersstrasse / Goldersdorf strasse Godersdorf Finkenstein 9585 Austria	Frankfurt	InterXion Weismüllerstrasse 21-23 BUILDING FRA3 1st Floor Rm 2-1C Frankfurt 60314 Germany
Vienna	InerXtion Louis-Häfliger-Gasse 10, Vienna 1210 Austria	Milan 1 Lancetti	Colt Via Lancetti 23 Building A Milan 20158 Italy
Brussels	Level 3 Avenue Leon Grosjean 2 Evere Brussels 1140 Belgium	Amsterdam	VANCIS B.V. RmS145 1st Floor Science Park 121 Amsterdam 1098 XG Netherlands
London	Telecity 8-9 Harbour Exchange London E14 9GE England	Geneva	IT-CS Building 513 385 route de Meyrin Geneva 23 1211 Switzerland
Paris	InterXion 45 Ave Victor Hugo Batiment 260 Aubervilliers Paris 93534 France		

Table 6.1: PoP addresses