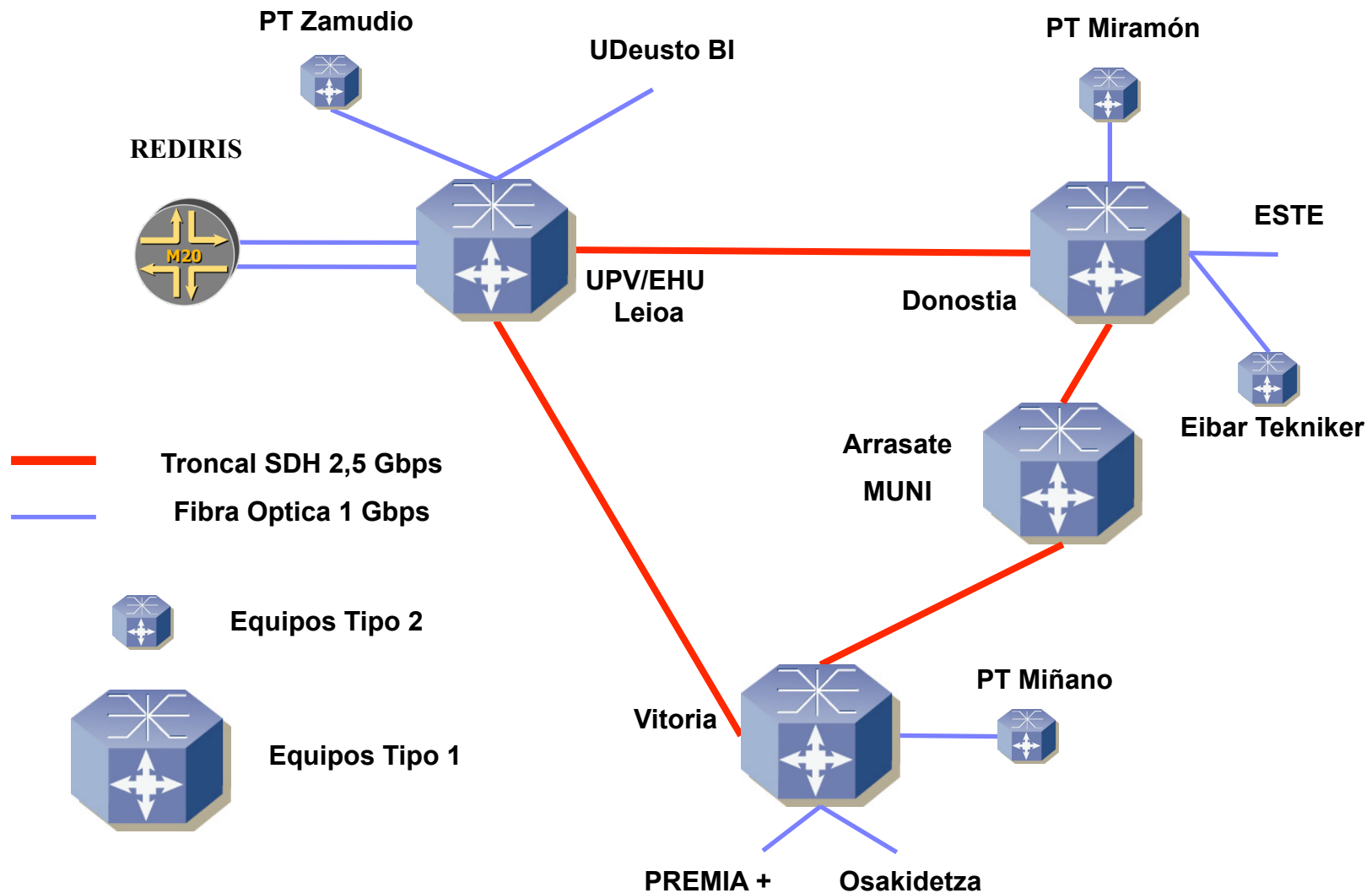


Despliegue de tecnología fotónica en i2basque

Josu Aramberri

josu.aramberri@ehu.es

Situación de partida



El proyecto

An Advanced Hybrid Optical and Packet Network

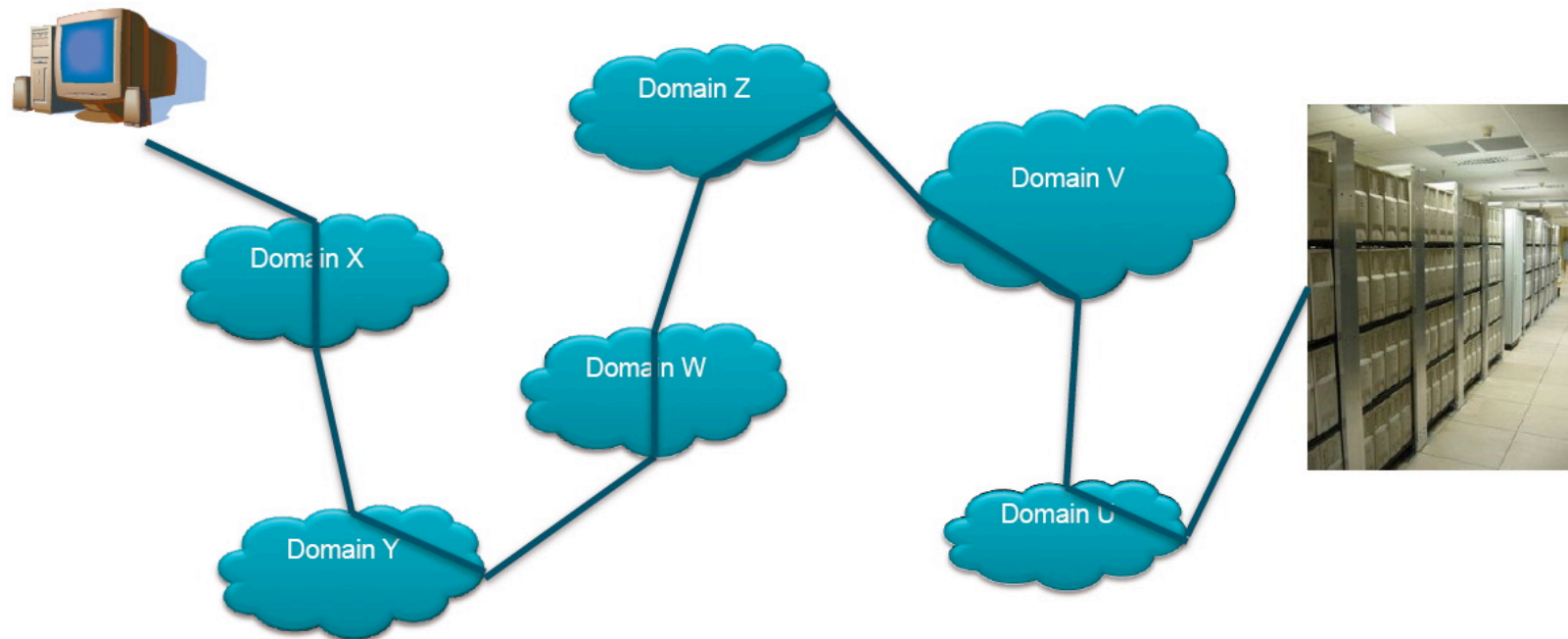
The Internet2 Network's physical implementation is made up of several robust, logically different, but related networks, each on its own overlaid infrastructure. These networks include:

- Advanced IP network (provided by Juniper routers)
- Dynamic Circuit network (provided by the the multiservice switching capabilities of the Ciena CoreDirectors)
- Core optical network (provided by the **Infinera platform**)



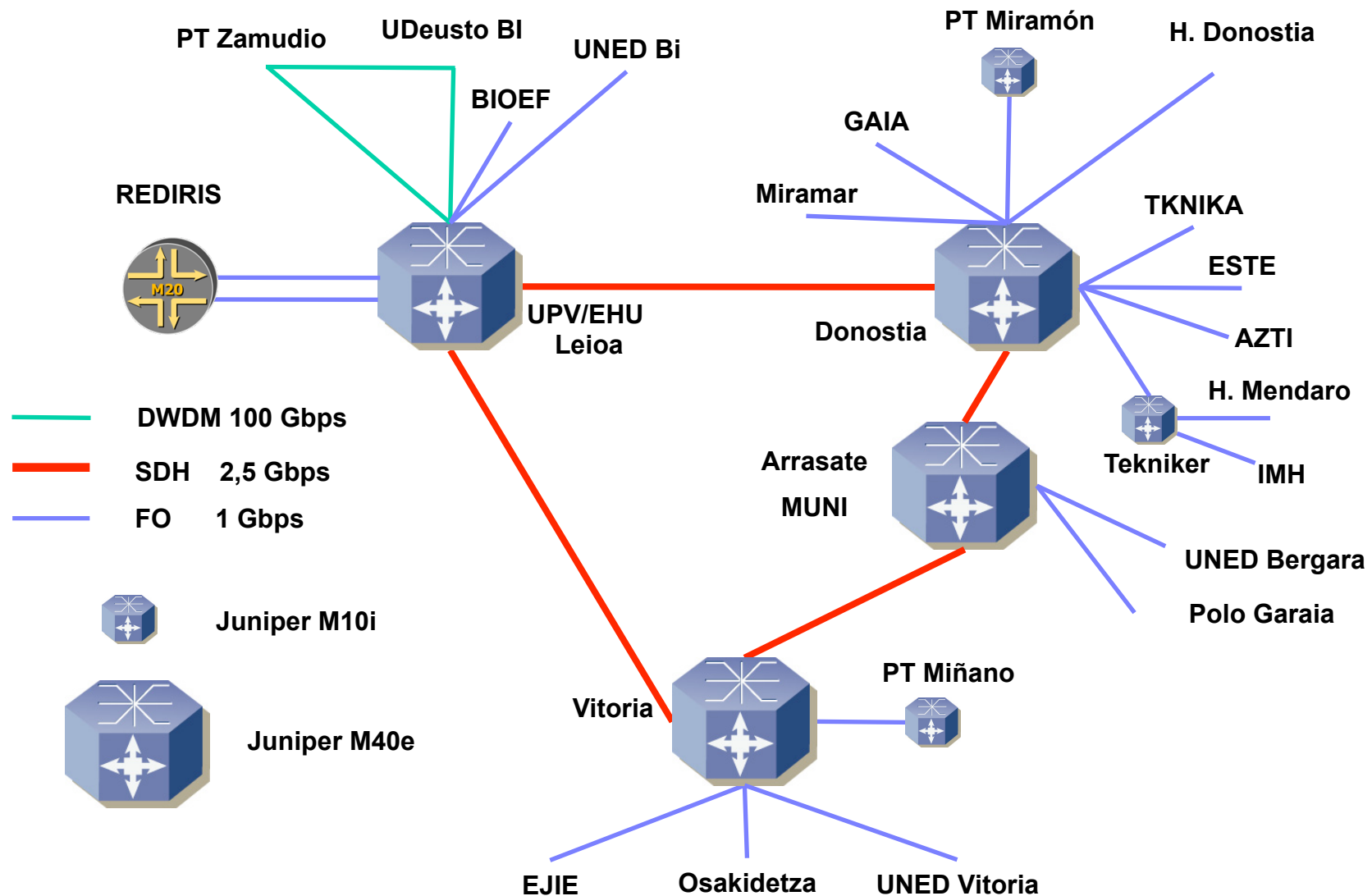
Hemos elegido los mismos equipos Internet 2 USA

Preparando el futuro

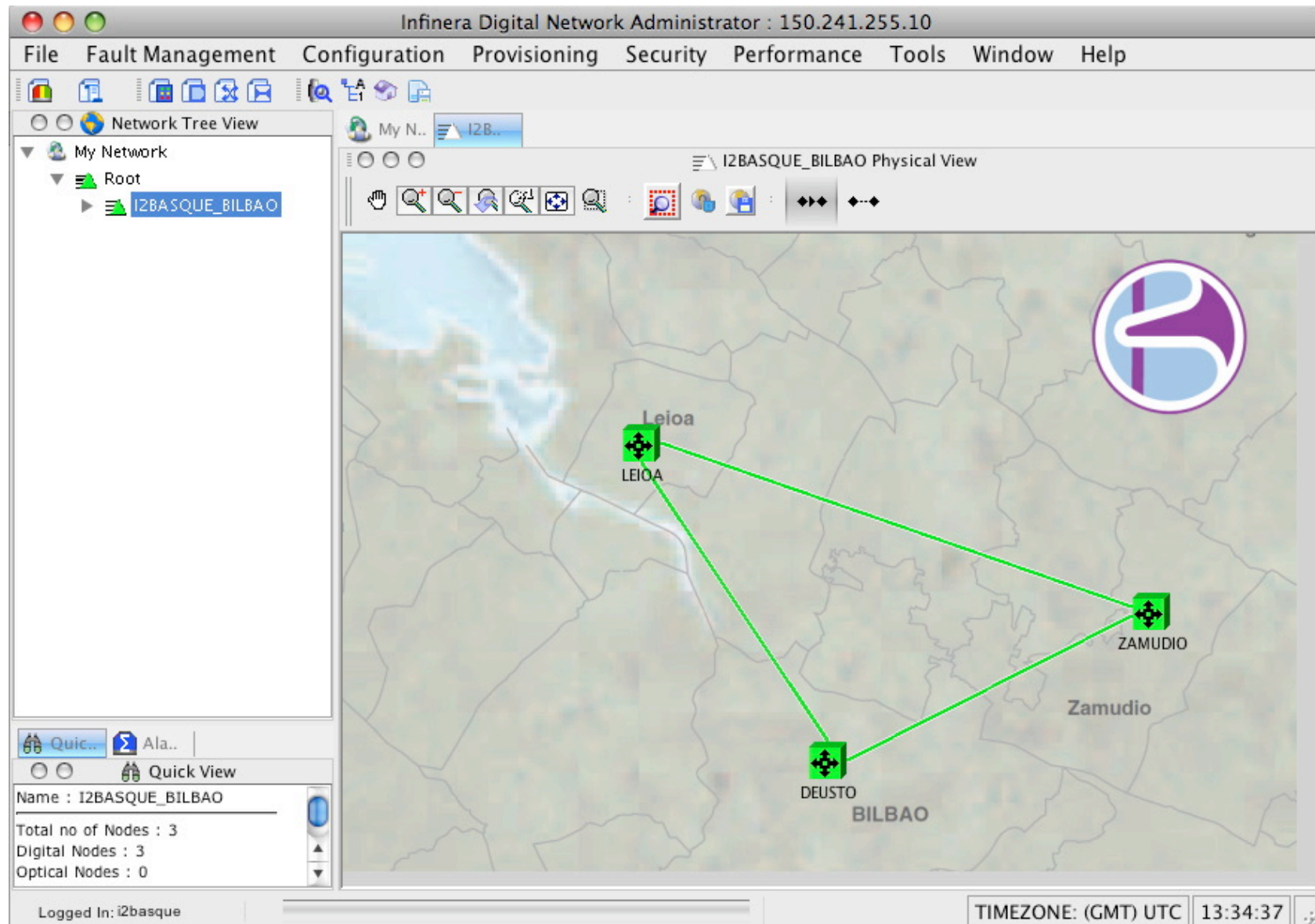


- Enlaces temporales de extremo a extremo

Anillo piloto



Anillo piloto



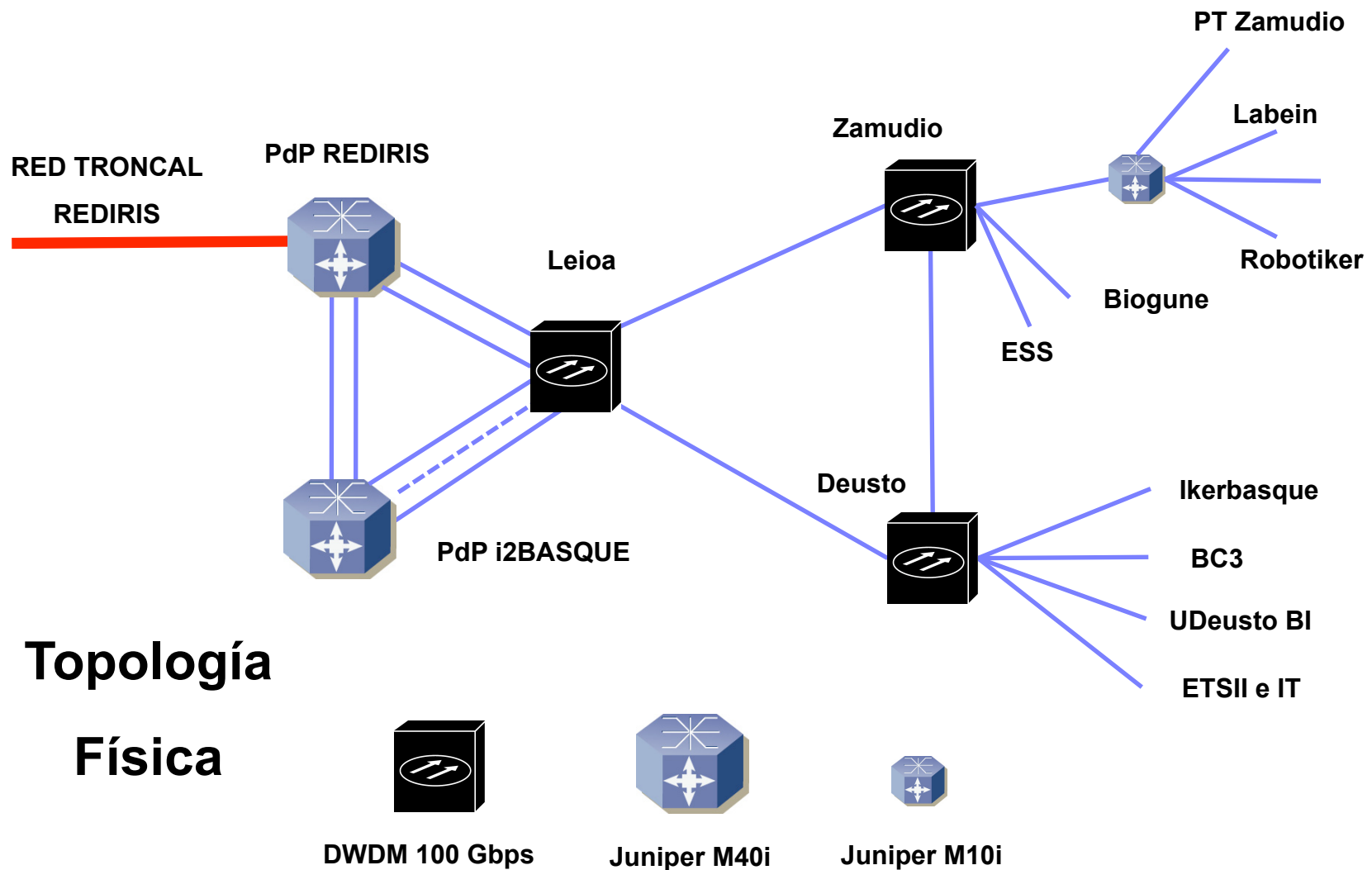
Emplazamiento estratégico

- Distancias geográficas de 10 a 20 Km
- Tendidos de fibra de 18 a 32 Km (reflectometrías)
- Concentración de entidades afiliadas
- Incluye el PoP de RedIRIS en el País Vasco
- Iniciativa ESFRI en Zamudio (www.essbilbao.com)

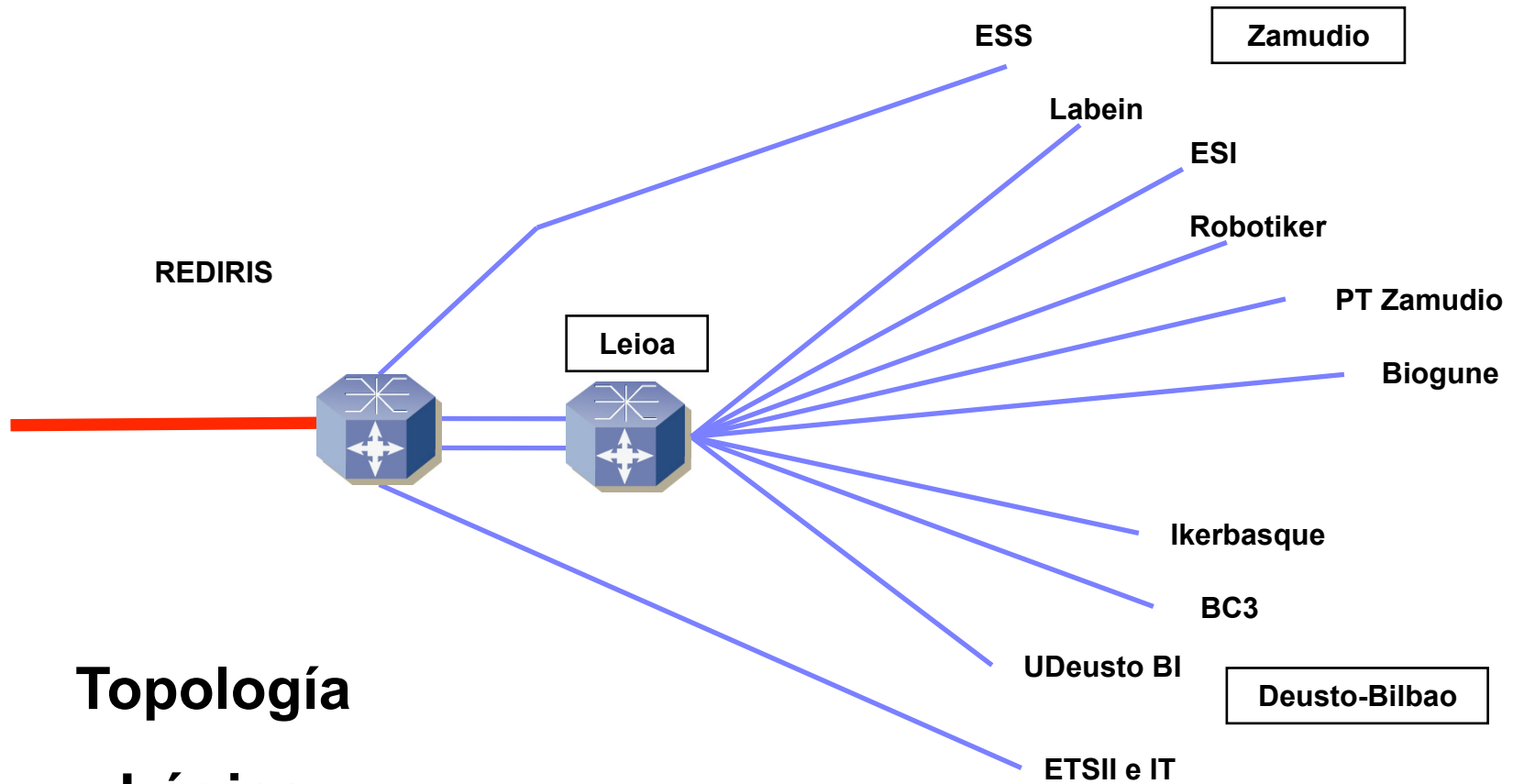
Un buen piloto la siguiente generación de i2basque

Un buen piloto para la red de eCiencia

Piloto i2BASQUE-Bilbao



Piloto i2BASQUE-Bilbao



Juniper M40i



Juniper M10i

ELIMINADO

Agentes implicados

- Universidades: UPV/EHU, Deusto
- Redes Académicas: RedIRIS, i2BASQUE
- Parque Tecnológico de Zamudio
- Iniciativa ESFRI ESS-Bilbao (www.essbilbao.com)
- Fabricante y proveedor: Infinera - Telindus

Proyectos relacionados: PASITO, FEDERICA

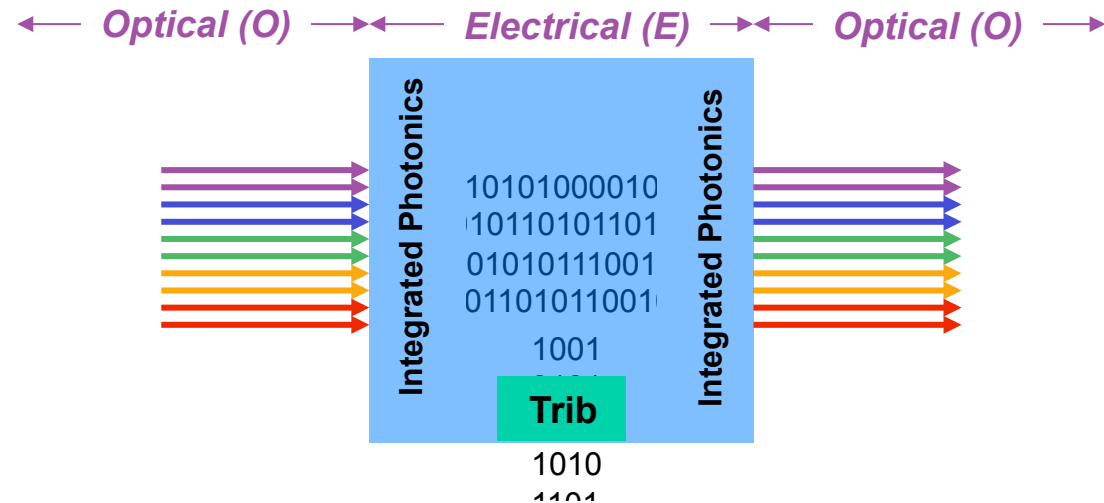
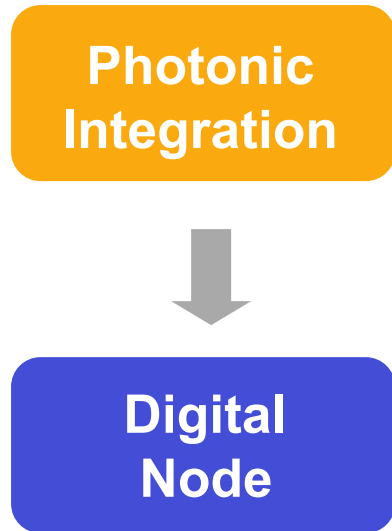
Integración Fotónica

Photonic Integration



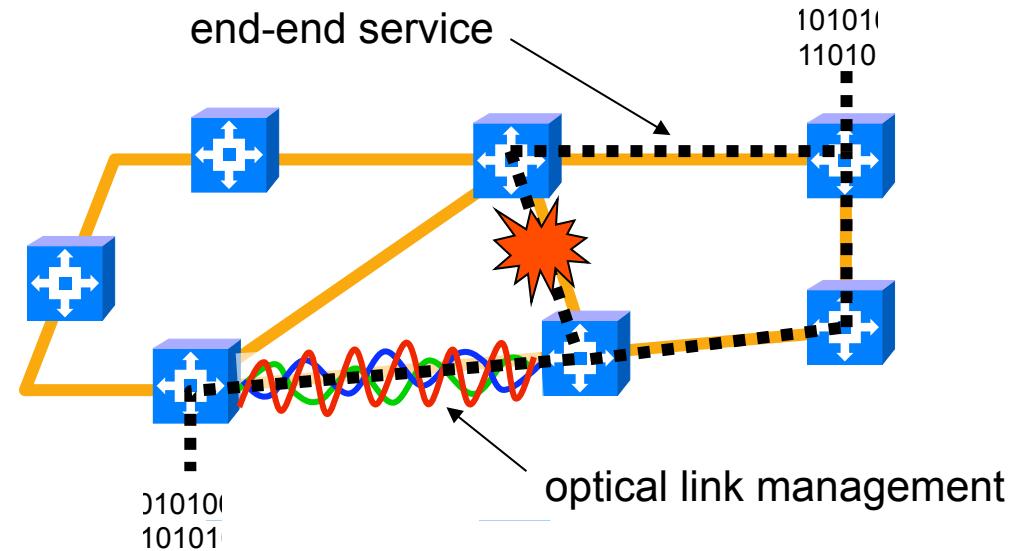
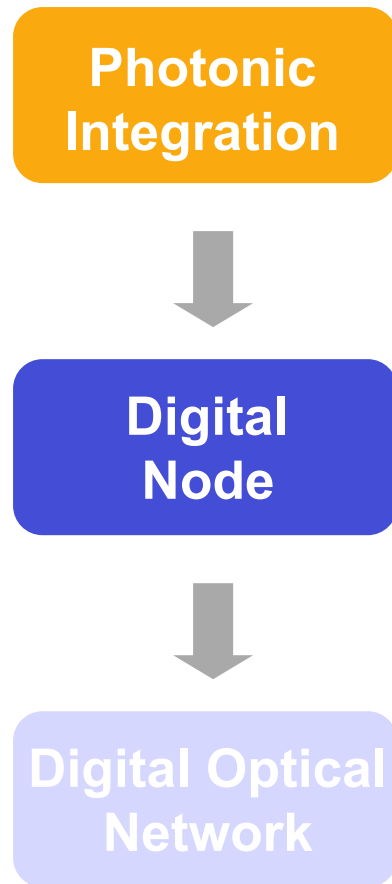
- Industry's first "Photonic Integrated Circuit"
- 100Gb/s "WDM system on a chip"
- 62 components on Tx & Rx PICs

Nodo Digital



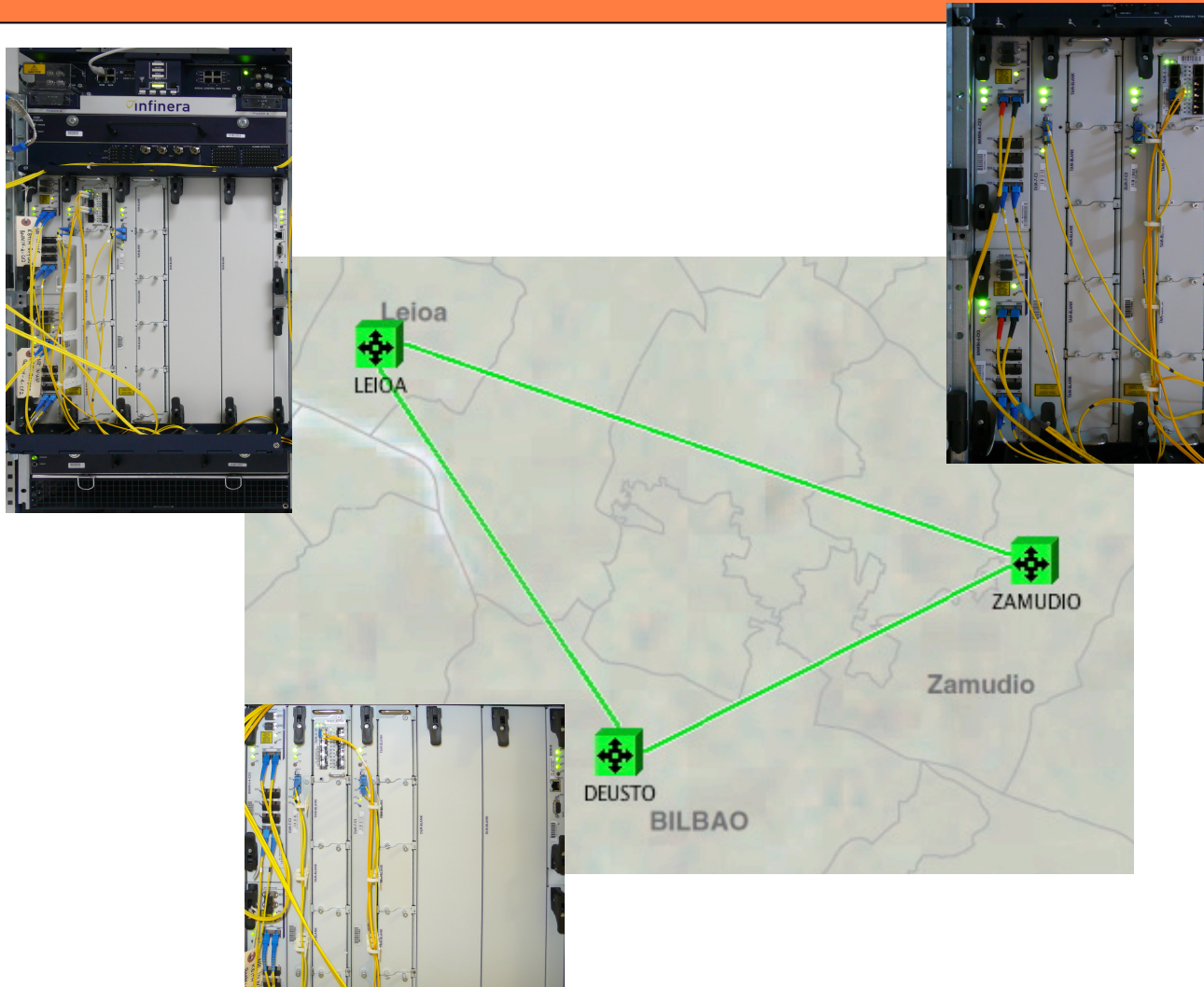
- OEO conversion enables “digital” functionality
- Multi-wavelength scaling using PICs
- Sub-I bandwidth management (ODU1)
- Separate tribs (service) from line (capacity)

Red Óptica

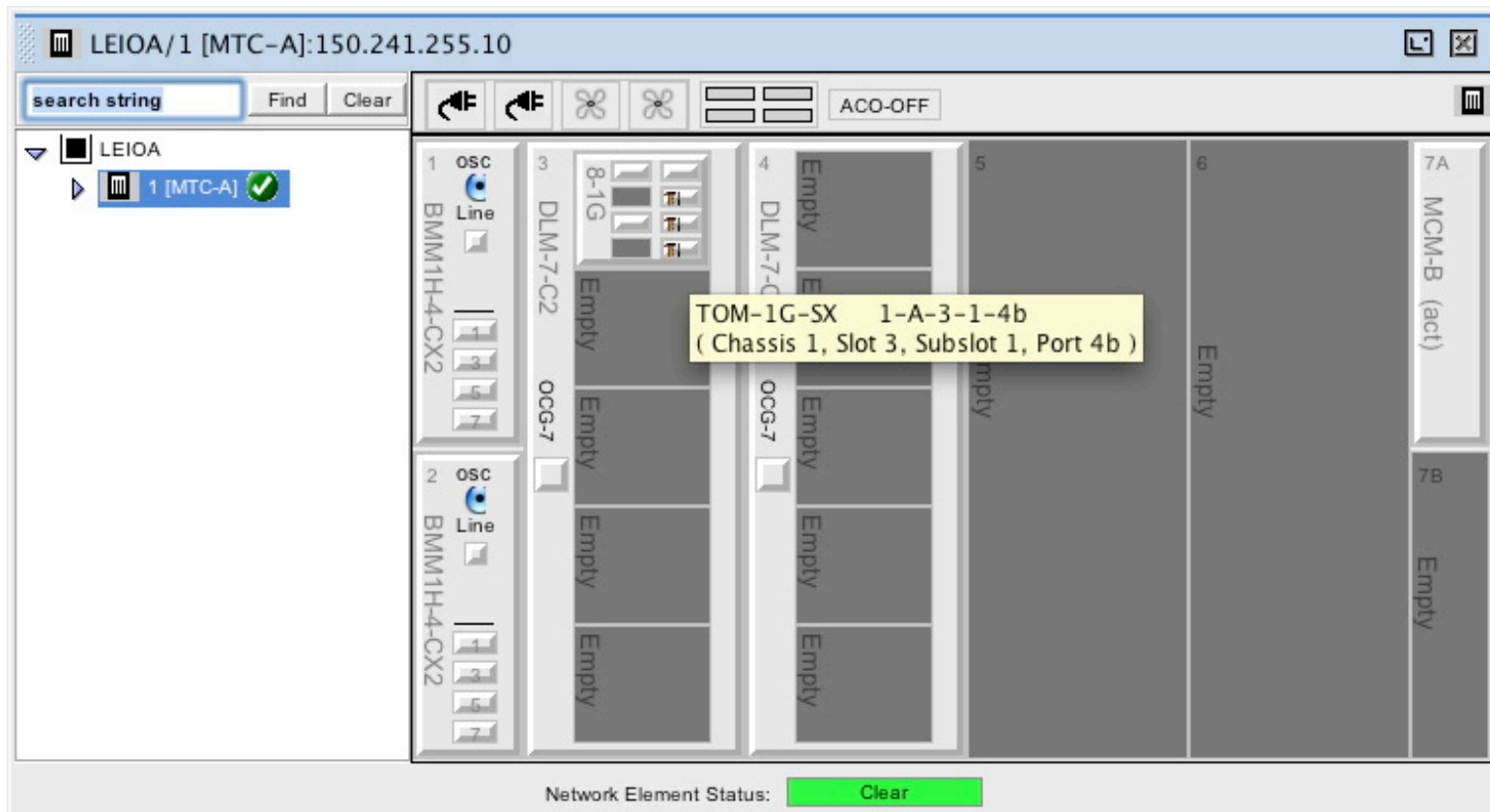


- De-couple service provisioning from optical engineering
- GMPLS software intelligence
- Digital switching at every node
- Unconstrained service delivery anywhere

Detalles i2BASQUE-Bilbao



Equipo de Leioa



Enlace Leioa-Deusto: lambdas

File Fault Management Configuration Provisioning Security Performance Tools Window Help

Network Tree View

- My Network
 - Root
 - I2BASQUE_BILBAO

Digital Channel Map Viewer: DEUSTO [1-A-1-01] <==> LEIOA [1-A-2-01]

(Cross-Connect Avail./ Cross-Connect Alloc./ Unadvtd.)

Terminating Nodes: LEIOA to DEUSTO

10G Channels 2.5G Timeslots

Source ==> Destination 9 / 0 / 0 37 / 3 / 0
 Destination ==> Source 9 / 0 / 0 37 / 3 / 0

Channels Details
 CID List None

Channel/TEInterface	Direction	LEIOA(Source)			Status	Composite Time Slot	DEUSTO(Destination)		
		Condition(s)	Label	Advt			Condition(s)	Label	Advt
OCG-7(1-A-4) / 1	↔	✓		True	█	OCG-7(1-A-3) / 1	✓		True
OCG-7(1-A-4) / 2	↔	✓		True	█	OCG-7(1-A-3) / 2	✓		True
OCG-7(1-A-4) / 3	↔	✓		True	█	OCG-7(1-A-3) / 3	✓		True
OCG-7(1-A-4) / 4	↔	✓		True	█	OCG-7(1-A-3) / 4	✓		True
OCG-7(1-A-4) / 5	↔	✓		True	█	OCG-7(1-A-3) / 5	✓		True
OCG-7(1-A-4) / 6	↔	✓		True	█	OCG-7(1-A-3) / 6	✓		True
OCG-7(1-A-4) / 7	↔	✓		True	█	OCG-7(1-A-3) / 7	✓		True
OCG-7(1-A-4) / 8	↔	✓		True	█	OCG-7(1-A-3) / 8	✓		True
OCG-7(1-A-4) / 9	↔	✓		True	█	OCG-7(1-A-3) / 9	✓		True
OCG-7(1-A-4) / 10	↔	✓		True	█ █ █ █	OCG-7(1-A-3) / 10	✓		True

Quick View

Name : I2BASQUE_BILBAO

Total no of Nodes : 3
 Digital Nodes : 3
 Optical Nodes : 0
 Peripheral Nodes : 0

Total no of Links : 9
 Physical Links : 3
 TE Links : 3
 DTN Links : 3
 Peripheral Links : 0

Refresh Export Close Help

Logged In: i2basque Channel Data Retrieved TIMEZONE: (GMT) UTC 13:35:57

Enlace Leioa-Deusto: lambdas

Digital Link Viewer: LEIOA-DEUSTO

Select OCG Group: LEIOA-DEUSTO(3,5,7,1)

LEIOA (DON)

Chassis 1 Slot 2
BMM1H-4-CX2
No. of Channels: 40

OPT: 10.40
OPR: 1.06

Current VOA: 16.11
Target VOA: 16.18
Adjusted at: 10-22 13:38::
Mid Stage: n/a
West Node

DEUSTO (DON)

Chassis 1 Slot 1
BMM1H-4-CX2
No. of Channels: 40

OPR: 0.89
OPT: 10.33

Current VOA: 16.27
Target VOA: 16.36
Adjusted at: 10-22 13:37::
Mid Stage: n/a
East Node

SL: 9.14
ESL: n/a

SL: 9.09
ESL: n/a

OCG 1	OCG 3	OCG 5	OCG 7	<<West East>>	OCG 1	OCG 3	OCG 5	OCG 7
LEIOA	LEIOA	LEIOA	LEIOA	Node Name	DEUSTO	DEUSTO	DEUSTO	DEUSTO
Chassis n/a Slot n/a None n/a n/a n/a n/a -43.68 : -6.48 n/a : n/a n/a n/a n/a	Chassis n/a Slot n/a None n/a n/a n/a None : -6.31 n/a : n/a n/a n/a n/a	Chassis n/a Slot n/a None n/a n/a n/a None : -5.45 n/a : n/a n/a n/a n/a	Chassis 1 Slot 4 Chassis 1 Slot 4 Unlocked Enabled Completed -13.34 : 8.86 8.26 : -13.09 [9E-12 - 1.1E-8] [9E-12 - 9E-12] [14.96 - 16.55]	Provisioned DLM Detected DLM DLM Admin State DLM Oper State AutoDiscovery BMM OCG OPR : OPT DLM OCG OPR : OPT Pre-FEC BER[min - max] Post-FEC BER[min - max] Q Val[min - max]	Chassis n/a Slot n/a None n/a n/a n/a n/a -44.02 : -6.34 n/a : n/a n/a n/a n/a	Chassis n/a Slot n/a None n/a n/a n/a None : -6.26 n/a : n/a n/a n/a n/a	Chassis n/a Slot n/a None n/a n/a n/a None : -5.23 n/a : n/a n/a n/a n/a	Chassis 1 Slot 3 Chassis 1 Slot 3 Unlocked Enabled Completed -13.82 : 8.43 8.48 : -12.82 [9E-12 - 3.7E-9] [9E-12 - 9E-12] [15.24 - 16.55]

OCG 7	Admin State		Oper State		OPT(dBm)		OPR(dBm)		Pre-FEC BER(10-Sec)		Post-FEC BER(10-Sec)		Q Val(dB)	
	West	East	West	East	West	East	West	East	West	East	West	East	West	East
Channel 1	Unlocked	Unlocked	Enabled	Enabled	-19.17	-19.17	-8.60	-8.45	5.2E-10	9E-12	9E-12	9E-12	15.71	16.55
Channel 2	Unlocked	Unlocked	Enabled	Enabled	-19.17	-19.18	-8.51	-8.21	9E-12	9E-12	9E-12	9E-12	16.55	16.55
Channel 3	Unlocked	Unlocked	Enabled	Enabled	-19.18	-19.17	-8.59	-8.21	1.2E-10	9E-12	9E-12	9E-12	16.04	16.55
Channel 4	Unlocked	Unlocked	Enabled	Enabled	-19.18	-19.18	-8.62	-8.40	9E-12	3.7E-9	9E-12	9E-12	16.55	15.24
Channel 5	Unlocked	Unlocked	Enabled	Enabled	-19.18	-19.18	-8.64	-8.51	9E-12	3.9E-10	9E-12	9E-12	16.55	15.78
Channel 6	Unlocked	Unlocked	Enabled	Enabled	-19.16	-19.18	-8.71	-8.57	8.7E-10	9E-12	9E-12	9E-12	15.59	16.55
Channel 7	Unlocked	Unlocked	Enabled	Enabled	-19.18	-19.17	-8.78	-8.64	2.7E-11	1.4E-10	9E-12	9E-12	16.34	15.99
Channel 8	Unlocked	Unlocked	Enabled	Enabled	-19.17	-19.18	-8.72	-8.53	1.1E-8	9E-12	9E-12	9E-12	14.96	16.55
Channel 9	Unlocked	Unlocked	Enabled	Enabled	-19.19	-19.18	-8.66	-8.38	9E-12	9E-12	9E-12	9E-12	16.55	16.55
Channel...	Unlocked	Unlocked	Enabled	Enabled	-19.18	-19.18	-8.66	-8.27	9E-12	9E-12	9E-12	9E-12	16.55	16.55

Last Updated: 2009-10-22 13:39:18Z

Collect Logs Refresh Print Close Help

Enlace protegido

Circuit Properties

End-to-End Service: 1 Port DSNCP
 1GbE
 SubCircuit...: 1-A-3-...

1) Current circuit creation - COMPLETED

Local Circuit | Remote Circuit

Details

Summary

Circuit ID (CID):
 Circuit ID (System): 1249385392.MA3207334823.1.1.1.3.1.1.1:
 Route Status: OnWorkingRoute
 Connectivity: Trib to Trib

Endpoint

Source: LEIOA | Destination: DEUSTO
 AID: 1-A-3-T1-1a | AID: 1-A-3-T1-1a

General | Sub-Snc Details | Channelized Details | Constraints | Route | **Circuit Layout**

LEIOA%1-A-3-T1-1a<---->DEUSTO%1-A-3-T1-1a[W-W] | Trace Type: La... | Export

Condition(s)	Hop	Node		Object Type	AID	Object Name	State	
		Name	Label				Admin	Oper
✓	1	LEIOA		Trib	1-A-3-T1-1a	Chassis 1 Slot 3	Unlocked	Enabled
✓	1	LEIOA		GbE LAN	1-A-3-T1-1a	Chassis 1 Slot 3	Unlocked	Enabled
✓	1	LEIOA		DTF Path	1-A-3-T1-1	Chassis 1 Slot 3	Unlocked	Enabled
✓	1	LEIOA		Cross-Connect	1-A-3-T1-1...	Chassis 1 Slot 3	Unlocked	Enabled
✓	1	LEIOA		DTF Path	1-A-4-L1-10-4	Chassis 1 Slot 4	Unlocked	Enabled
✓	1	LEIOA		Optical Channel	1-A-4-L1-10	Chassis 1 Slot 4	Unlocked	Enabled
✓	1	LEIOA		DLM OCG Port	1-A-4-L1	Chassis 1 Slot 4	Unlocked	Enabled
✓	1	LEIOA		BMM OCG Port	1-A-2-T4	Chassis 1 Slot 2	Unlocked	Enabled
✓	1	LEIOA		OTS Port	1-A-2-L1	Chassis 1 Slot 2	N/A	Enabled
✓	2	DEUSTO		OTS Port	1-A-1-L1	Chassis 1 Slot 1	N/A	Enabled
✓	2	DEUSTO		BMM OCG Port	1-A-1-T4	Chassis 1 Slot 1	Unlocked	Enabled
✓	2	DEUSTO		DLM OCG Port	1-A-3-L1	Chassis 1 Slot 3	Unlocked	Enabled
✓	2	DEUSTO		Optical Channel	1-A-3-L1-10	Chassis 1 Slot 3	Unlocked	Enabled
✓	2	DEUSTO		DTF Path	1-A-3-L1-10-4	Chassis 1 Slot 3	Unlocked	Enabled
✓	2	DEUSTO		Cross-Connect	1-A-3-L1-10...	Chassis 1 Slot 3	Unlocked	Enabled
✓	2	DEUSTO		DTF Path	1-A-3-T1-1	Chassis 1 Slot 3	Unlocked	Enabled
✓	2	DEUSTO		GbE LAN	1-A-3-T1-1a	Chassis 1 Slot 3	Unlocked	Enabled

Reload | Delete | Back | Next | Apply | Cancel | Close | Help

Camino completo

Circuit Summary

Circuit ID: Service: Auto Restorable: Route Status: Protection Status:

Filters

Time Interval: 24 Hrs 15 Mins

Node Filter: Show Diagnostics: Reverse Circuit Direction

Facility Filter:

2010-06-04 2010-06-11*
2010-06-04 2010-06-11*

ZAMUDIO(DON)(REA)

- Port 2a: TOM-1G-LX Trib Port
- Subslot 1: TAM-8-1G Trib DTF
- Chassis 1 Slot 3: DLM-7-C2 Line DTF
- Chassis 1 Slot 1: BMM1H-4-CX2 OTS

DEUSTO(DON)(REA)

- Chassis 1 Slot 4: DLM-7-C2 Line DTF
- Chassis 1 Slot 3: DLM-7-C2 Line DTF
- Chassis 1 Slot 2: BMM1H-4-CX2 OTS
- Chassis 1 Slot 1: BMM1H-4-CX2 OTS

LEIOA(DON)(REA)

- Port 2a: TOM-1G-LX Trib Port
- Subslot 1: TAM-8-1G Trib DTF
- Chassis 1 Slot 4: DLM-7-C2 Line DTF
- Chassis 1 Slot 2: BMM1H-4-CX2 OTS

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

PM Data Retrieved

Client CTP

Circuit Summary
 Circuit ID: PROT Leioa-Zamudio Service: 1GbE Auto Restorable: Route Status: OnWorkingRoute Protection Status: HotStby-HotStby

Filters
 Node Filter: Src & Dest Nodes Show Diagnostics: None Reverse Circuit Direction:
 Time Interval: 24 Hrs (selected) 15 Mins
 Facility Filter: Client CTP (selected), DTF Path, Optical Channel, DLM OCG Port

15Min Current Stats at 2010-06-11 09:50:52

ZAMUDIO - GbE Client (Chassis 1, Slot 4, Client 1, Port 2a)		<< West East >>		LEIOA - GbE Client (Chassis 1, Slot 3, Client 1, Port 2a)	
Rx	Tx			Rx	Tx
0	0		ES-S	0	0
0	0		SES-S	0	0
n/a	n/a		SEFS-S	n/a	n/a

Refre...

ZAMUDIO(DON)(REA)
 Port 2a: TOM-1G-LX (checked), Trib Port (checked), GbE Client (checked)
 Chassis 1 Slot 1: BMM1H-4-CX2 (checked), OTS (checked)

LEIOA(DON)(REA)
 Port 2a: TOM-1G-LX (checked), Trib Port (checked), GbE Client (checked)
 Chassis 1 Slot 2: BMM1H-4-CX2 (checked), OTS (checked)

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

PM Data Retrieved

DTF Path

Circuit Summary
 Circuit ID: PROT Leioa-Zamudio | Service: 1GbE | Auto Restorable: | Route Status: OnWorkingRoute | Protection Status: HotStby-HotStby

Filters
 Node Filter: Src & Dest Nodes | Show Diagnostics: None | Reverse Circuit Direction:

Time Interval
 24 Hrs | 15 Mins
 2010-06-04 | 2010-06-11*

ZAMUDIO(DON)(REA)

- Port 2a: TOM-1G-LX (Trib Port) ✓
- Subslot 1: TAM-8-1G (Trib DTF) ✓
- Chassis 1 Slot 3: DLM-7-C2 (Line DTF) ✓
- Chassis 1 Slot 1: BMM1H-4-CX2 (OTS) ✓

LEIOA(DON)(REA)

- Port 2a: TOM-1G-LX (Trib Port) ✓
- Subslot 1: TAM-8-1G (Trib DTF) ✓
- Chassis 1 Slot 4: DLM-7-C2 (Line DTF) ✓
- Chassis 1 Slot 2: BMM1H-4-CX2 (OTS) ✓

15Min Current Stats at 2010-06-11 09:50:52

ZAMUDIO - GbE Client (Chassis 1, Slot 4, Client 1, Port 2a)		<< West East >>		LEIOA - GbE Client (Chassis 1, Slot 3, Client 1, Port 2a)	
Rx	Tx			Rx	Tx
0	0		ES-S	0	0
0	0		SES-S	0	0
n/a	n/a		SEFS-S	n/a	n/a

[Refre...](#)

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

PM Data Retrieved

Canal óptico

Circuit Summary
 Circuit ID: PROT Leioa-Zamudio Service: 1GbE Auto Restorable: Route Status: OnWorkingRoute Protection Status: HotStby-HotStby

Filters
 Node Filter: Src & Dest Nodes Show Diagnostics: None Reverse Circuit Direction:
 Time Interval: 24 Hrs (selected) 15 Mins
 Facility Filter: Client CTP, DTF Path, **Optical Channel**, DLM OCG Port

15Min Current Stats at 2010-06-11 09:50:52

ZAMUDIO - GbE Client (Chassis 1, Slot 4, Client 1, Port 2a)		<< West East >>		LEIOA - GbE Client (Chassis 1, Slot 3, Client 1, Port 2a)	
Rx	Tx			Rx	Tx
0	0		ES-S	0	0
0	0		SES-S	0	0
n/a	n/a		SEFS-S	n/a	n/a

Refre...

ZAMUDIO(DON)(REA)
 Port 2a: TOM-1G-LX (Trib Port) ✓
 Chassis 1 Slot 3: DLM-7-C2 (Optical Channel 10) ✓
 Chassis 1 Slot 1: BMM1H-4-CX2 (OTS) ✓

LEIOA(DON)(REA)
 Port 2a: TOM-1G-LX (Trib Port) ✓
 Chassis 1 Slot 4: DLM-7-C2 (Optical Channel 10) ✓
 Chassis 1 Slot 2: BMM1H-4-CX2 (OTS) ✓

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

PM Data Retrieved

DLM OCG Port

Circuit Summary
 Circuit ID: PROT Leioa-Zamudio | Service: 1GbE | Auto Restorable: | Route Status: OnWorkingRoute | Protection Status: HotStby-HotStby

Filters
 Node Filter: Src & Dest Nodes | Show Diagnostics: None | Reverse Circuit Direction:
 Time Interval: 24 Hrs (selected) | 15 Mins
 Facility Filter: DLM OCG Port (selected)

15Min Current Stats at 2010-06-11 09:50:52

ZAMUDIO - GbE Client (Chassis 1, Slot 4, Client 1, Port 2a)		<< West East >>		LEIOA - GbE Client (Chassis 1, Slot 3, Client 1, Port 2a)	
Rx	Tx			Rx	Tx
0	0		ES-S	0	0
0	0		SES-S	0	0
n/a	n/a		SEFS-S	n/a	n/a

Refresh: Refre...

ZAMUDIO(DON)(REA)
 Port 2a: TOM-1G-LX (Trib Port) ✓
 Chassis 1 Slot 3: DLM-7-C2 (DLM OCG) ✓
 Chassis 1 Slot 1: BMM1H-4-CX2 (OTS) ✓

LEIOA(DON)(REA)
 Port 2a: TOM-1G-LX (Trib Port) ✓
 Chassis 1 Slot 4: DLM-7-C2 (DLM OCG) ✓
 Chassis 1 Slot 2: BMM1H-4-CX2 (OTS) ✓

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

PM Data Retrieved

BMM OCG Port

Circuit Summary
 Circuit ID: PROT Leioa-Zamudio Service: 1GbE Auto Restorable: Route Status: OnWorkingRoute Protection Status: HotStby-HotStby

Filters
 Node Filter: Src & Dest Nodes Show Diagnostics: None Reverse Circuit Direction:
 Time Interval: 24 Hrs (selected) 15 Mins
 Facility Filter: DTF Path, Optical Channel, DLM OCG Port, **BMM OCG Port**

15Min Current Stats at 2010-06-11 09:50:52

ZAMUDIO - GbE Client (Chassis 1, Slot 4, Client 1, Port 2a)		<< West East >>		LEIOA - GbE Client (Chassis 1, Slot 3, Client 1, Port 2a)	
Rx	Tx			Rx	Tx
0	0		ES-S	0	0
0	0		SES-S	0	0
n/a	n/a		SEFS-S	n/a	n/a

Refre...

ZAMUDIO(DON)(REA)
 Port 2a: TOM-1G-LX (checked), Trib Port
 Chassis 1 Slot 1: BMM1H-4-CX2 (checked), **BMM OCG** (checked), OTS (checked)

LEIOA(DON)(REA)
 Port 2a: TOM-1G-LX (checked), Trib Port
 Chassis 1 Slot 2: BMM1H-4-CX2 (checked), **BMM OCG** (checked), OTS (checked)

Peer Properties | Circuit PM | PRBS Test PM | Client Signal Test PM

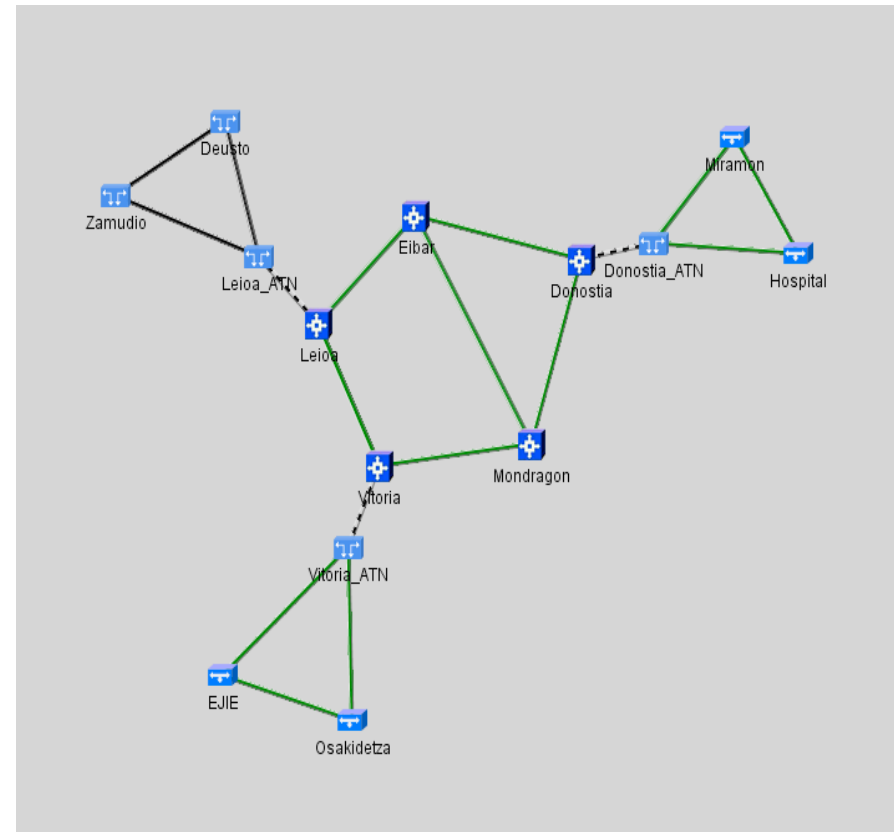
Attribute Name	Base Facility	Peer Facility

Refresh Now | Print | Export | Close | Help

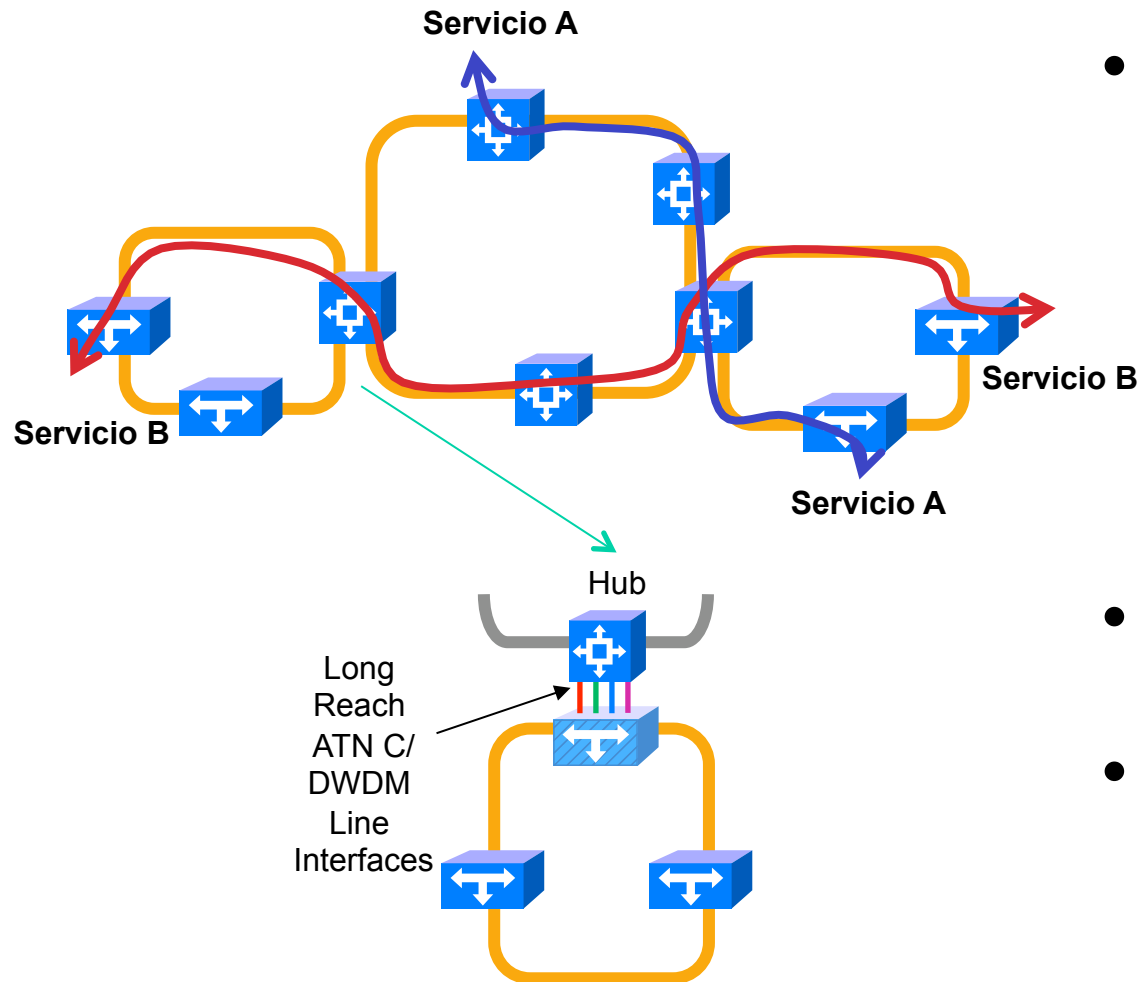
PM Data Retrieved

Futuro: i2basque XXI

- Red Multiservicio, conexión entre todos los PdP
 - Soportando servicios de GbE, FC 100/200/400, STM-1/4/16, y de servicios de 10Gbps (STM-64, 10GbE LAN/WAN, FC 10Gbps), y superiores.
- Anillos Metropolitanos con equipos ATN (utilización conjunta D/CWDM)
 - Leioa: DWDM, 10 x 10 Gbps por sección.
 - Donostia: CWDM, 8 x 10/2.5Gbps por sección.
 - Vitoria: CWDM, 8 x 10/2.5 Gbps por sección.
 - Integración ATN-DTN: ahorro en tarjetas y mayor funcionalidad.
- Core basado en equipos DTN
 - Capacidad de 400 Gbps por sección.
 - Doble anillo, mayor tasa de supervivencia de la red gracias a la restauración GMPLS.



i2basque XXI: anillos metropolitanos



- Anillos Metropolitanos
 - CWDM (Vitoria y Donostia)
 - DWDM en Leioa.
 - Nodos ATN equipados con:
 - 8 Puertos multiservicio (GbE, FC, STM-1/4/16)
 - Nodo ATN Hub:
 - Filtros 8 lambdas CWDM o 10 lambdas DWDM.
 - Conexión coloreada a módulos TAM-2-10GT en el DTN.
- Servicios protegidos desde los nodos ATN hasta el Hub.
 - Protección óptica 1 + 1
- La interconexión ATN-DTN permite transmitir cualquier servicio a cualquier nodo de la red.

Retos conjuntos

- Las Redes Nacionales (como RedIRIS) y las autonómicas (como i2basque) se preparan para “entregar” a las redes corporativas nuevos servicios que pide el usuario final
 - Redes dedicadas: PASITO, HPC, CineGrid, Salud
 - Conexión “end-to-end” investigador-ICTS
- ¿Hay iniciativas similares en las redes corporativas?

PROPUESTA: un GT sobre estos temas