Haute école d'ingénierie et d'architecture Fribourg
Hochschule für Technik und Architektur Freiburg

Planification, déploiement et exploitation de réseaux.

5. Réseaux Switch et EIA-FR.

Hes·so FRIBOURG FREIBURG
Haute Ecole Spécialisée de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences and Arts Western Switzerland

2018 | Dr. J. Robadey

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- Switch
  - Connections internationales
  - Organisation et Architecture du réseau Switch
  - Capacité actuelle et évolution
  - Connection avec les sites fribourgeois …
- Réseau de l'école
  - Connection avec UniFR
  - *Réseau de base:*
    - *architecture et topologie*
    - *les 3 niveaux hierarchiques*
  - *Les différents sites*
  - *Evolution*

Switch

Il était une fois …

fondateurs de switch

Historique

- **La "Genèse" de SWITCHlan:**
  En 1989, SWITCH a écrit un chapitre de l'histoire nationale:
  pour la première fois, il a été possible d'interconnecter directement toutes les universités suisses via SWITCHlan. Ce nom voulait dire que SWITCH construisait un réseau à même d'interconnecter les ordinateurs des hautes écoles aussi bien que le LAN (Local Area Network) à l'intérieur d'une université.
- **Une nouvelle étape technologique**
  SWITCHlan a ainsi été en 1989 une étape technologique pour la communication au sein du réseau scientifique national. A l'époque, la bande passante de raccordement était encore de **64 ou 128kbit/s**.
- **Une fibre optique, de multiples possibilités**
  Actuellement, SWITCHlan est établi depuis longtemps comme réseau performant, redondant et ainsi largement exempt de perturbations. Pour assurer la capacité, Switch utilise la fibre optique et le " Multiplexage en longueurs d'ondes ".

SWITCHlan Backbone

Darkfibers

SWITCHlan backbone node

SWITCHlan (technical) nodes

SWITCHlan node with external peerings

Project — Lightpaths

Provider — Internet transit

IX — Internet exchange

Network — Research and education network

SWITCH

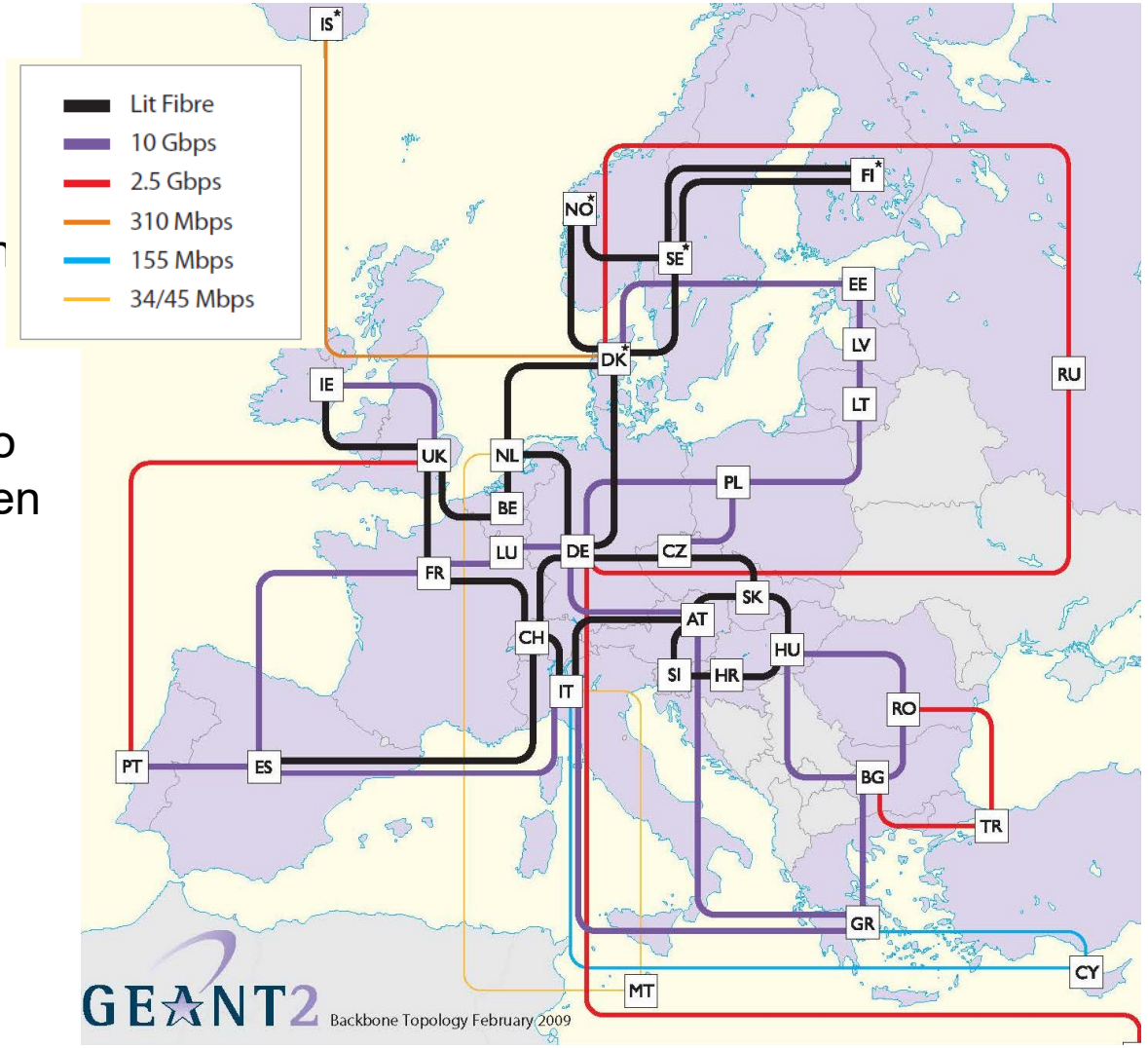
Interconnections avec GÉANT2.

First international hybrid research and education network.

The GÉANT2 network connects 34 countries through 30 national research and education networks (NRENs).

The first links came into service in 2005, between **Switzerland** and Italy, and **Switzerland** and Germany, respectively.

Multiple 10Gbps wavelengths are being employed in the network's core.



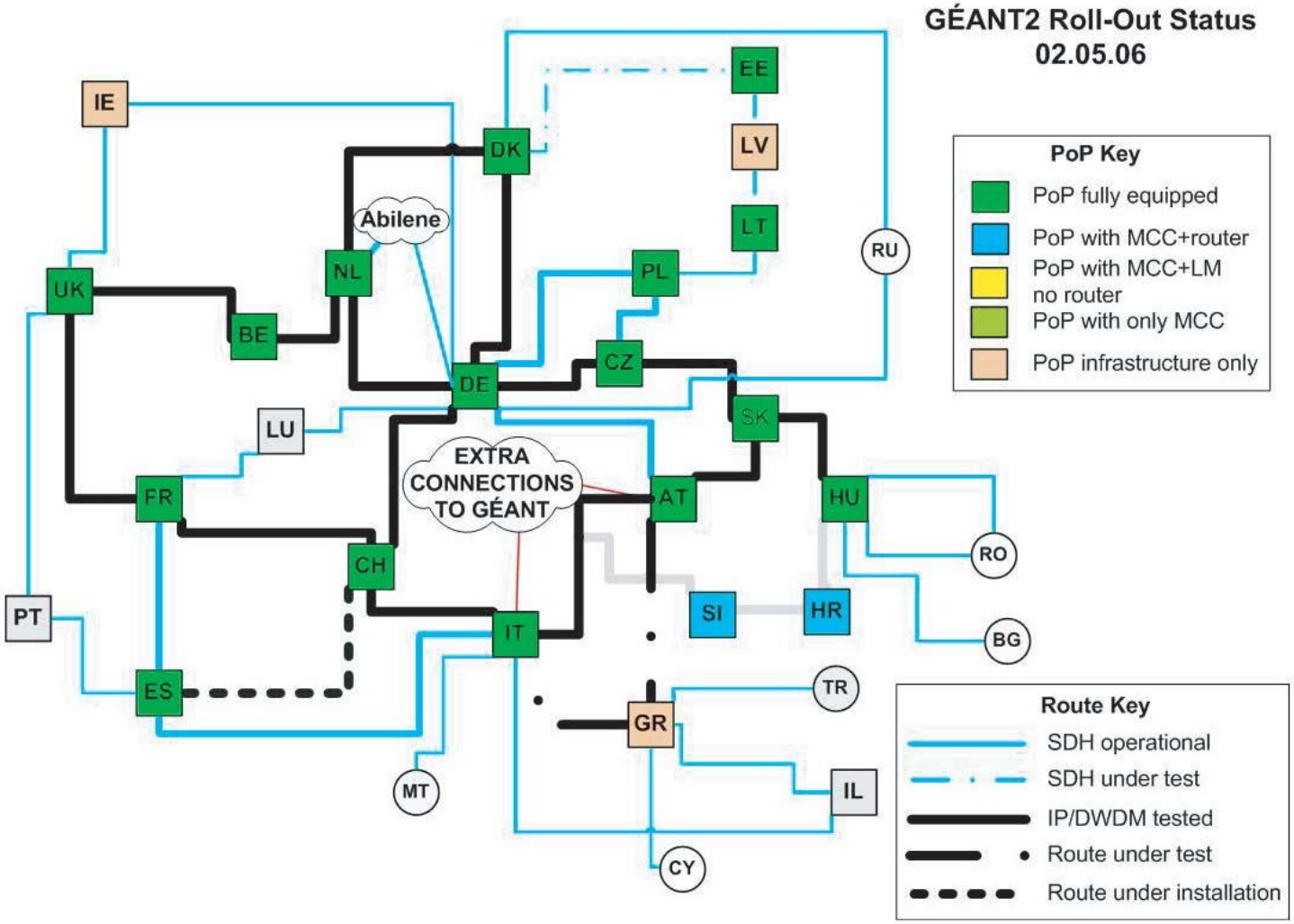
Objectifs du design de GÉANT2.

- GÉANT2's design objective is to maximize operational and service flexibility. The ability to handle the increase in future traffic patterns is crucial to its success.
- The expectations for future traffic flows on GÉANT2 contradict the traditional view of research networking (large numbers of users with small requirements). The prediction is that in future, a small but increasing numbers of users and projects will individually be transferring high volumes of data.
- GÉANT2's design has taken into account:
  - User requirements for basic IP service
  - The rate of development of applications with demands for dedicated high-speed connectivity between a limited number of sites
  - Technical and economic implications of transmission and equipment choices to accommodate routing and switching
  - Availability of connectivity
  - Progress on standards development.
- Reliability during development + introduction of new technologies = key requirement.
  → Balance between introduction of innovation where required + retention of existing technology when it is recognized as "doing the job“.

Migration GÉANT vers GÉANT2.

- The migration from GÉANT to GÉANT2 has demanded meticulous planning that needed to be:
- Precise, because continuity of service had to be guaranteed
- Flexible, because it is impossible to be certain of the order of events when multiple suppliers are involved.
- The success of the project's migration planning has been demonstrated by its achievement of a seamless transition from the GÉANT network to GÉANT2, offering uninterrupted, reliable service.
- The public tenders for GÉANT2 connectivity, and equipment and management services were launched in January and July 2004 respectively. A decision on the basic design, technologies and topology of the network was announced in mid-June 2005, with the first links coming into service in December 2005.

Rollout final Géant2.



Last Update: GN4-3N, a european success story

Co-funded by the EU and by Europe's NRENs with a total budget of €50.5M, the GÉANT GN4-3N project successfully delivered the most significant restructuring of the GÉANT backbone network in over a decade, designed to drive digital inclusion and support the needs of Europe's research and education community for the next 15+ years.

GN4-3N

26,047 km

OF DARK FIBRE AND SPECTRUM LIT

261

PHYSICAL SPANS

69

ROUTES FULLY DEPLOYED

€50.5M

TOTAL BUDGET

Other infos:

Data Carried

9PB

9 Petabytes of data carried per day

Traffic Growth

+30%

Average annual increase in network traffic over last five years

Backbone Capacity

12Tb

Up to 12 Terabits per second backbone capacity

Availability

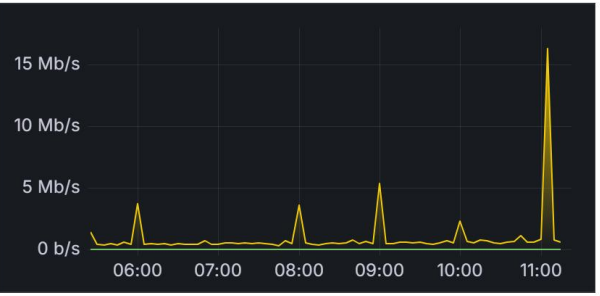
99.999%

Average availability

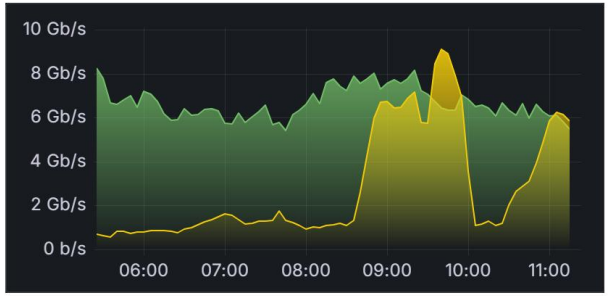
GÉANT Network Data

The BRIAN (Backbone Router Interface Analytics) framework helps authorised network managers and planners more easily access, edit, and share traffic data from the GÉANT network. The graphs below give an up-to-the-minute snapshot of selected routes.
If you would like to learn more about BRIAN click here or to visit the BRIAN website click here

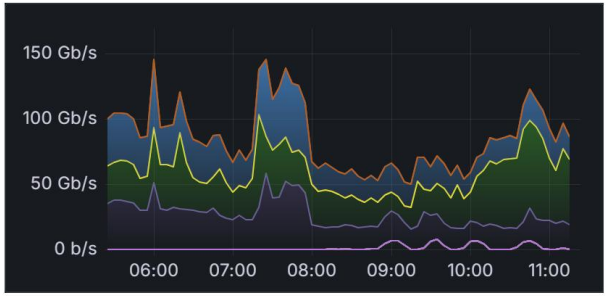
ESnet London



CAE-1

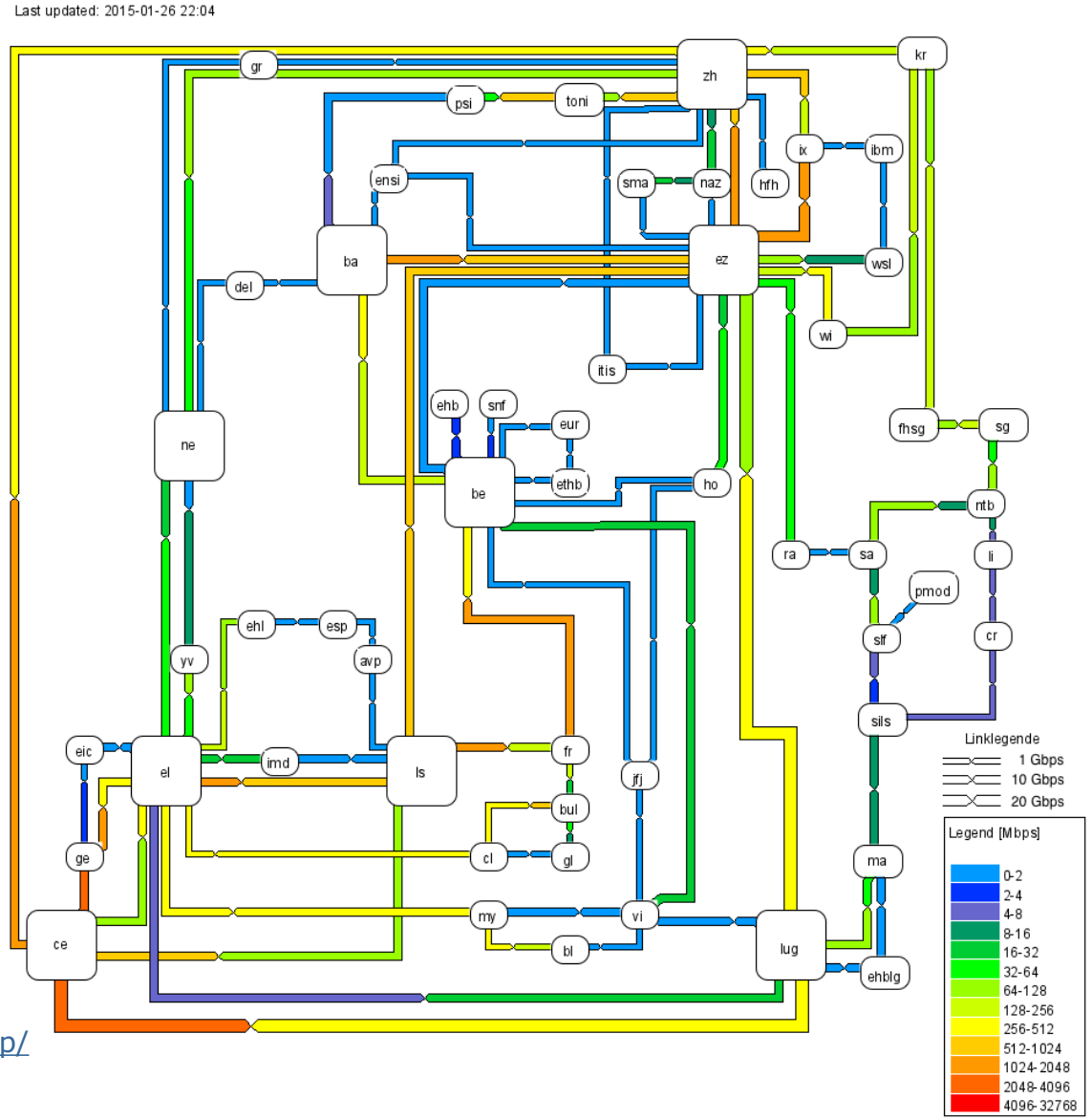


LHCONE Aggregate Ingress



https://connect.geant.org/2021/07/07/welcome-brian-backbone-router-interface-analytics

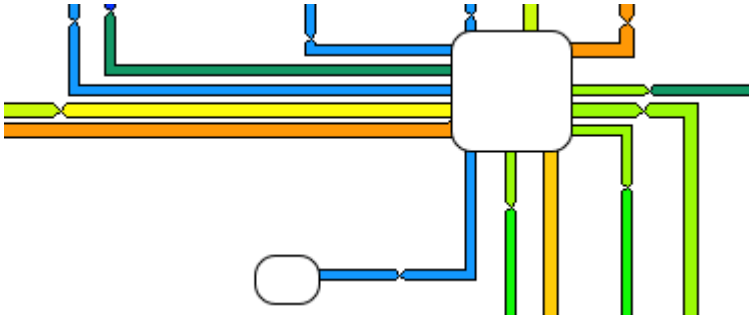
Retournons à Switch: switch weather map.



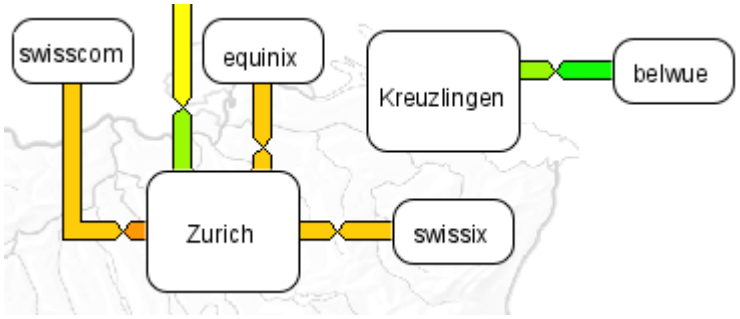
https://network.switch.ch/pub/swiss-map/

Switch Traffic viewer.

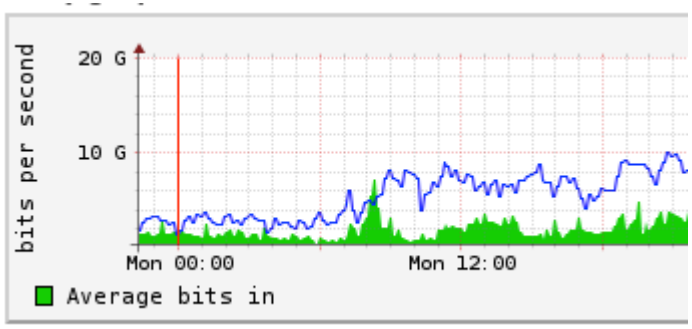
https://network.switch.ch/pub/swiss-map/



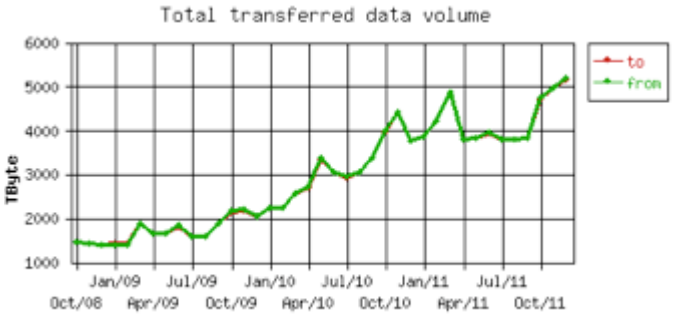
https://network.switch.ch/pub/international-map/



Site Traffic Graph



Monthly statistics



Internet Peering et transit: appairage en mode Internet et transit.

- **Rappel**: l'Internet moderne n'a plus de dorsale (*backbone*) dans le sens traditionnel. En effet, celui-ci existe plutôt via l'interconnexion de différents Fournisseurs d'Accès Internet (FAI ou ISP) et de réseaux privés. Ils sont tous connectés via leurs **points d'appairage** et utilisent le protocole de routage BGP qui leur permet de coordonner les opérations inhérentes au fonctionnement de l'Internet sans aucune autorité centrale.
- Quand deux entités ont besoin de réunir leurs réseaux, elles disposent de deux options : utiliser le **transit** (payant), utiliser **l'appairage** (souvent gratuit entre des réseaux de taille comparable).
- Les ISP configurent des points d'appairage, les endroits physiques où les échanges de connexions se déroulent et négocient les spécificités de l'appairage. La plupart des points d'appairage sont situés dans des centres de colocation (*data centers*) où les différents opérateurs réseaux centralisent leurs points de présence (PoP).

Source: wikipedia

SWITCHlan Backbone

- Darkfibers
- SWITCHlan backbone node
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SWITCH

Nouvelle plateforme optique de Switch.

Recalling the claimed goals:

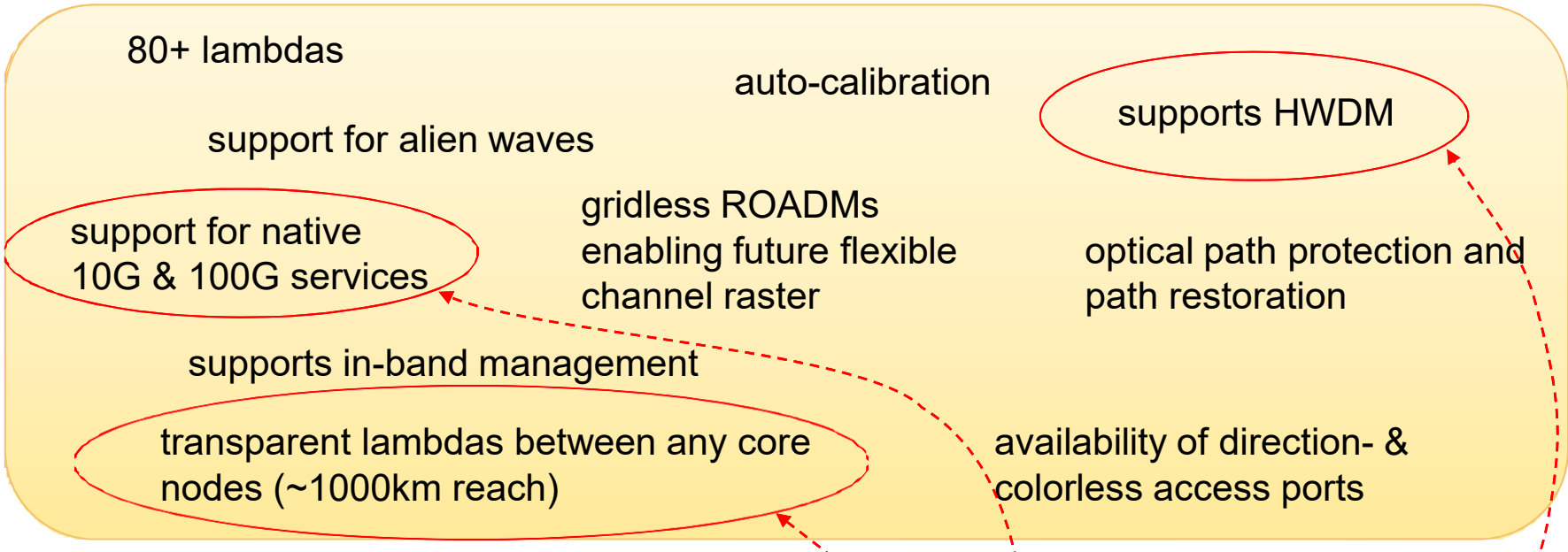
- a new, efficient, scalable optical transport system
- sufficient bandwidth reserves for another decade
- enhanced operational flexibility
- improved overall network stability
- enlarged footprint

The resulting areas of activity:

- topological modifications and moderate extensions
- deployment of first **100G-400G routers**
- complete rebuild of the optical transport system

Optical Transmission Layer.

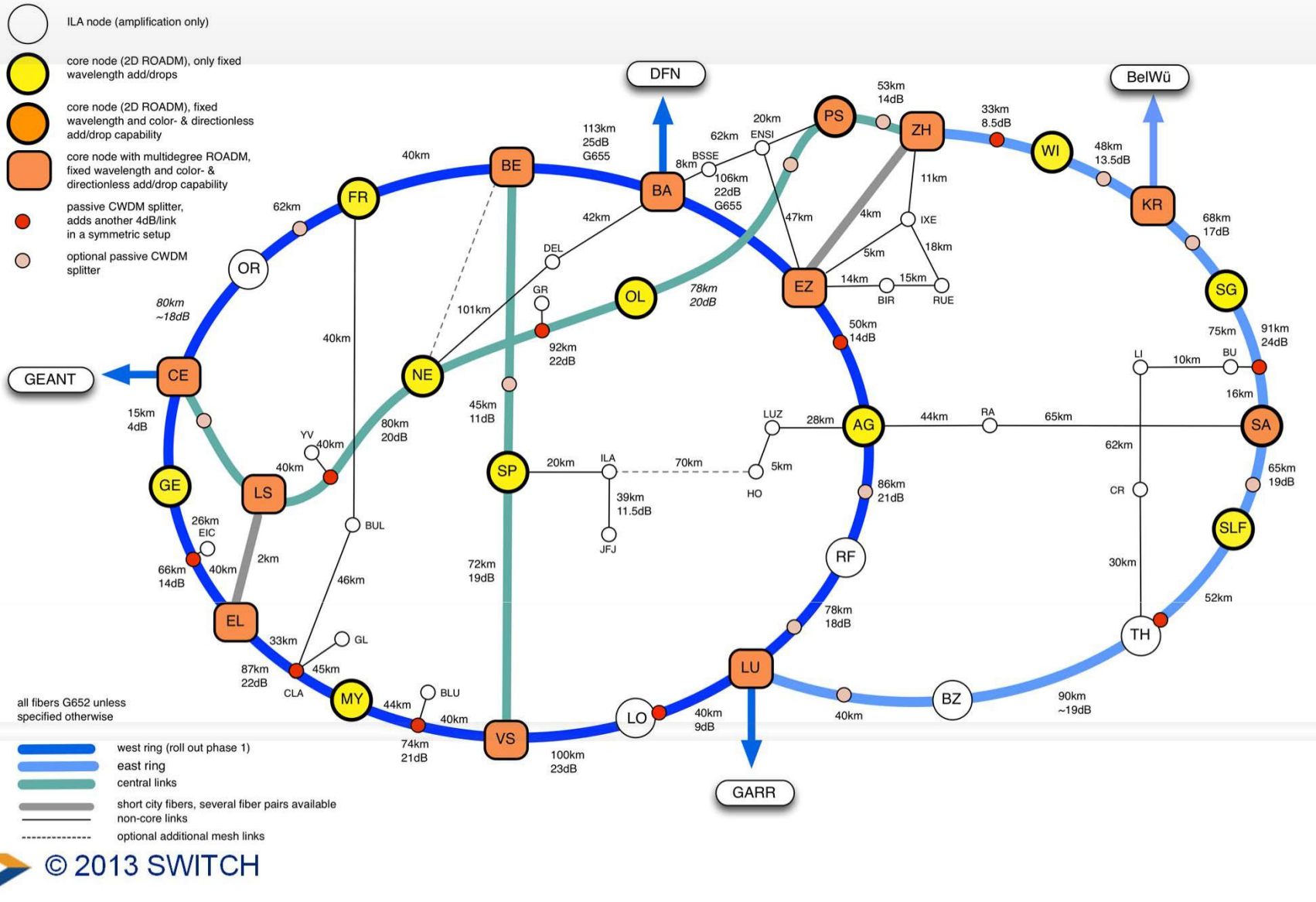
Key requirements for our new optical transport platform



Most requirements are pretty common today.

Some stirred more discussion

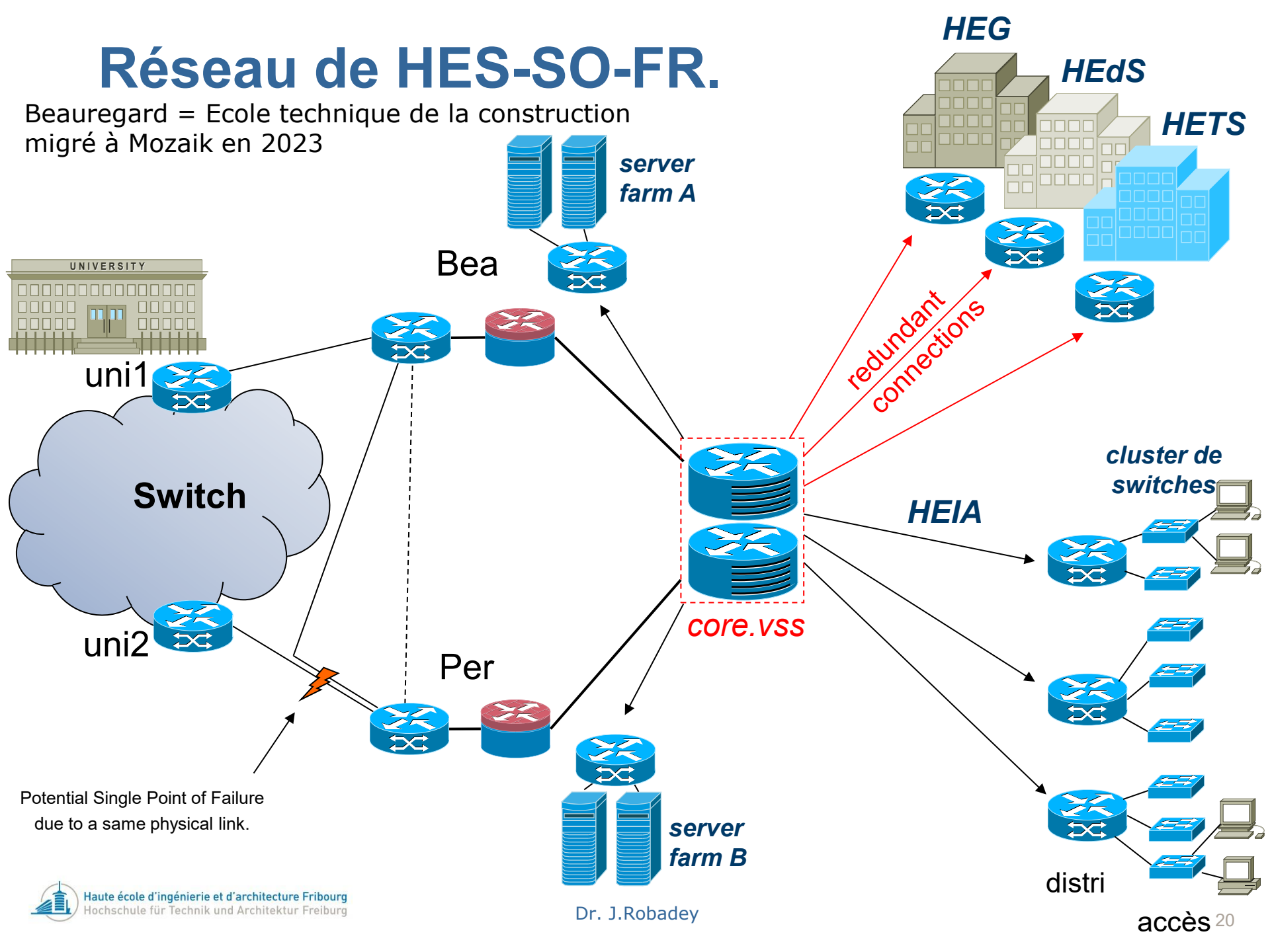
Planned SWITCHlan backbone 2015.



EIA-FR

Réseau de HES-SO-FR.

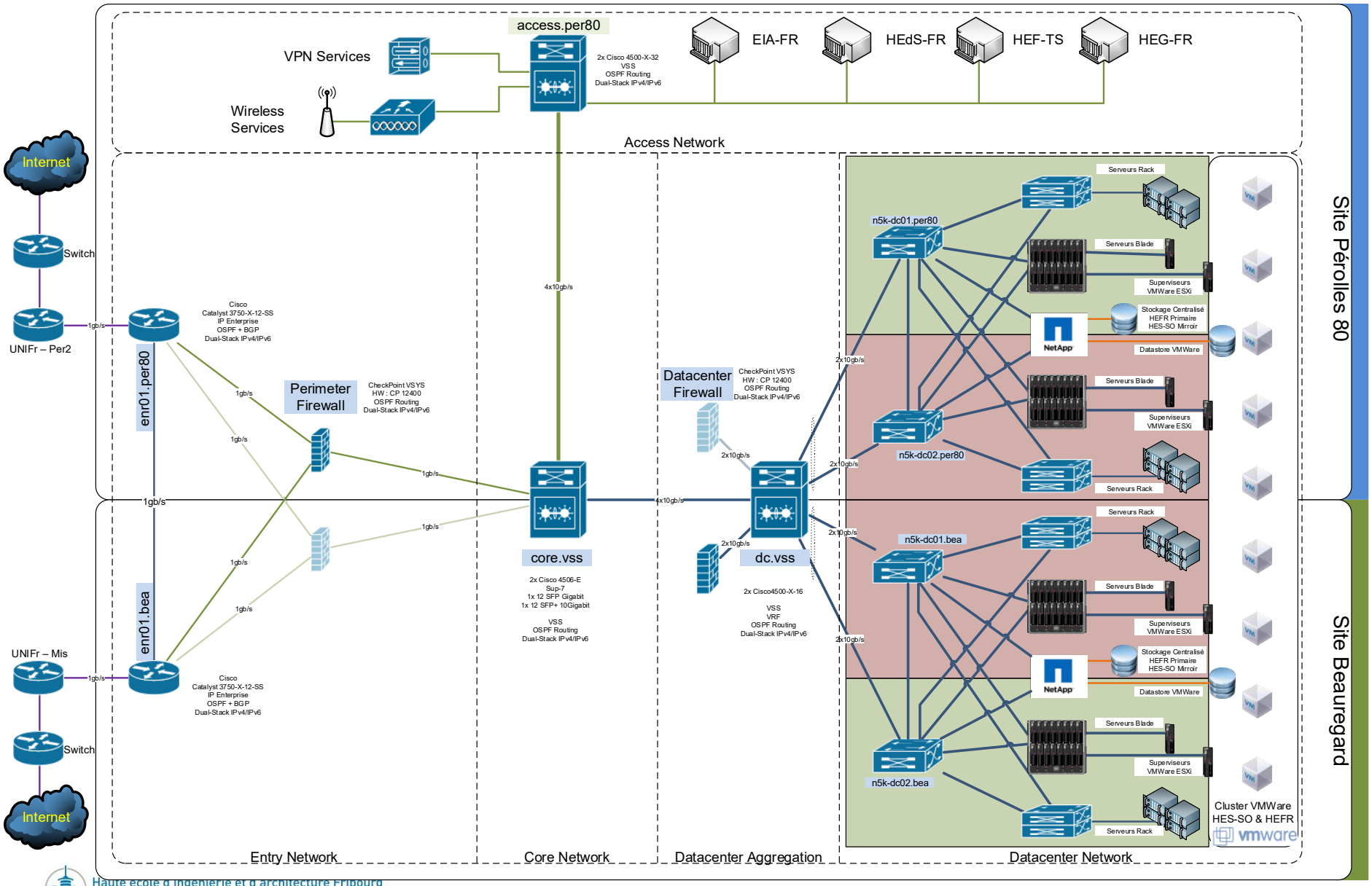
Beauregard = Ecole technique de la construction
migré à Mozaik en 2023



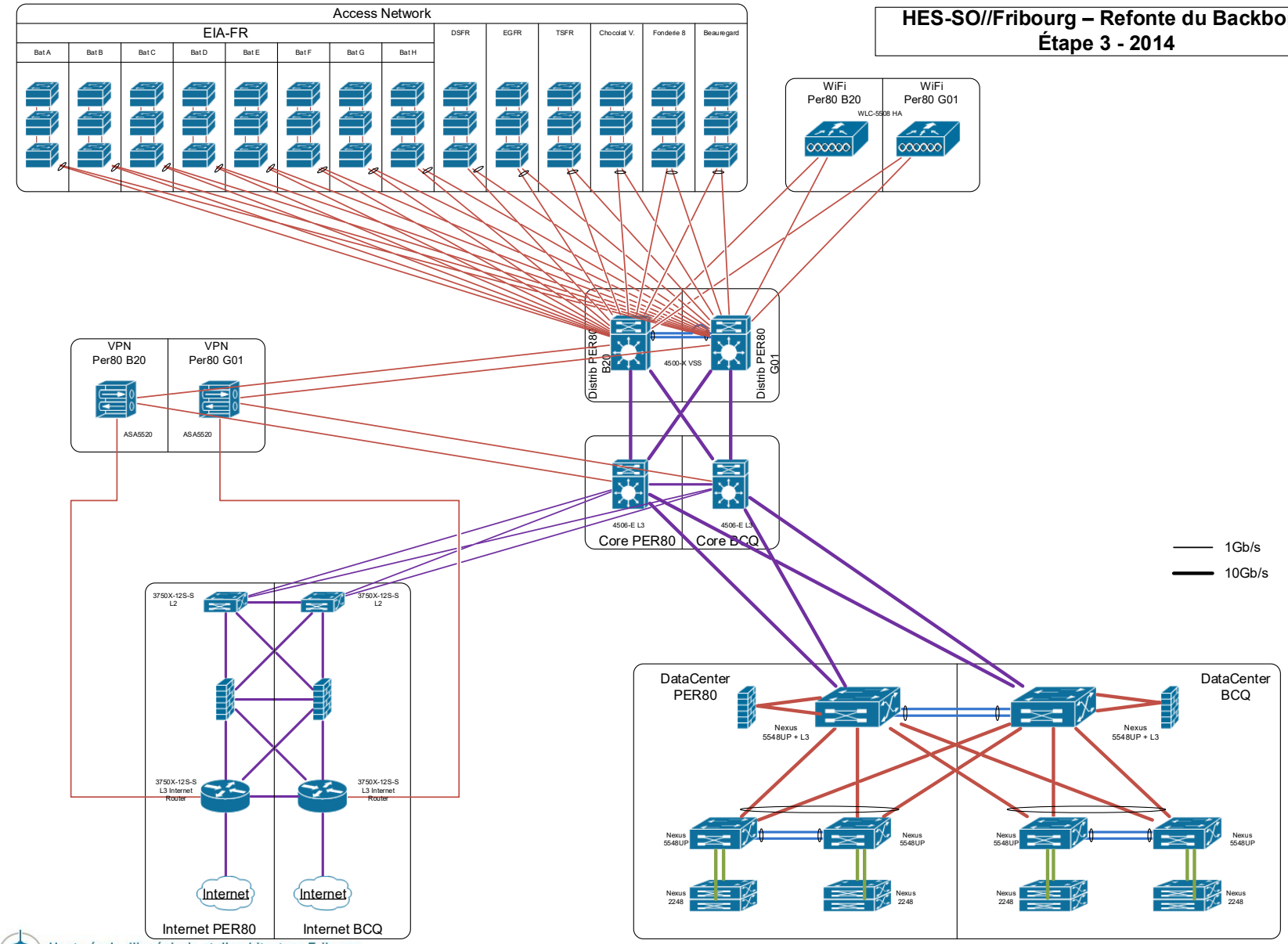
Potential Single Point of Failure
due to a same physical link.

Réseau HES-SO//Fribourg - 2014

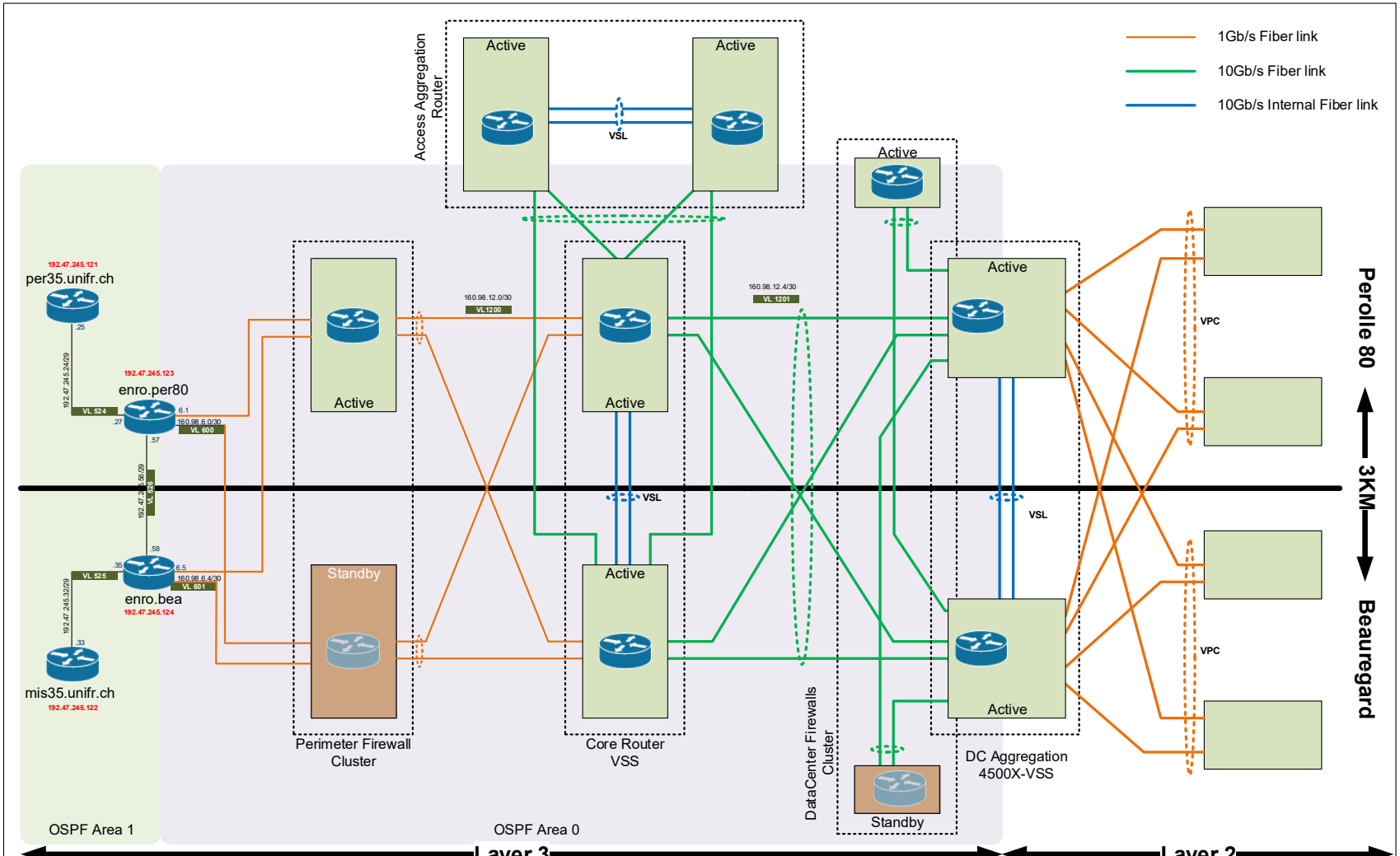
O. Beytrison



Objectif 2014.



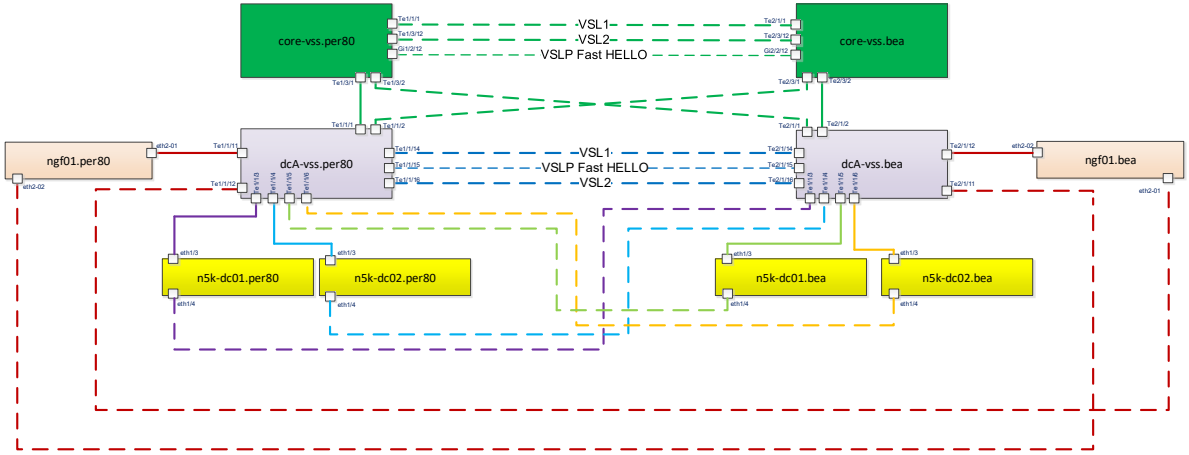
Core Network.



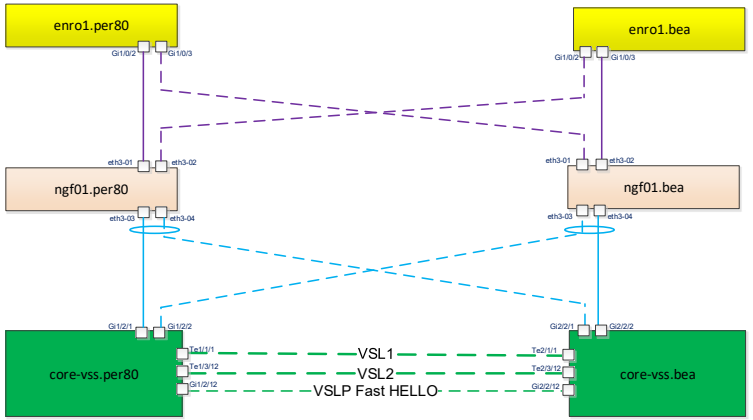
Hes·so FRIBOURG FREIBURG	Date 15.11.2013
Bd. Pérolles 80 1705 Fribourg Tél: +41 26 429 66 11 Fax: +41 26 429 66 00 web: http://www.eif.ch	Version 1.0 Visa Auteur O. Beytrison Fichier schémas-réseau_EIF.vsdx
Core Network Routage / Adressage OSPF without VRF	

Plan câblage DataCenter Network.

global



Plan des entrées



Merci de votre attention !

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HES-SO//Fribourg - EIA-FR