RENATER-5 network : DWDM architecture and usages

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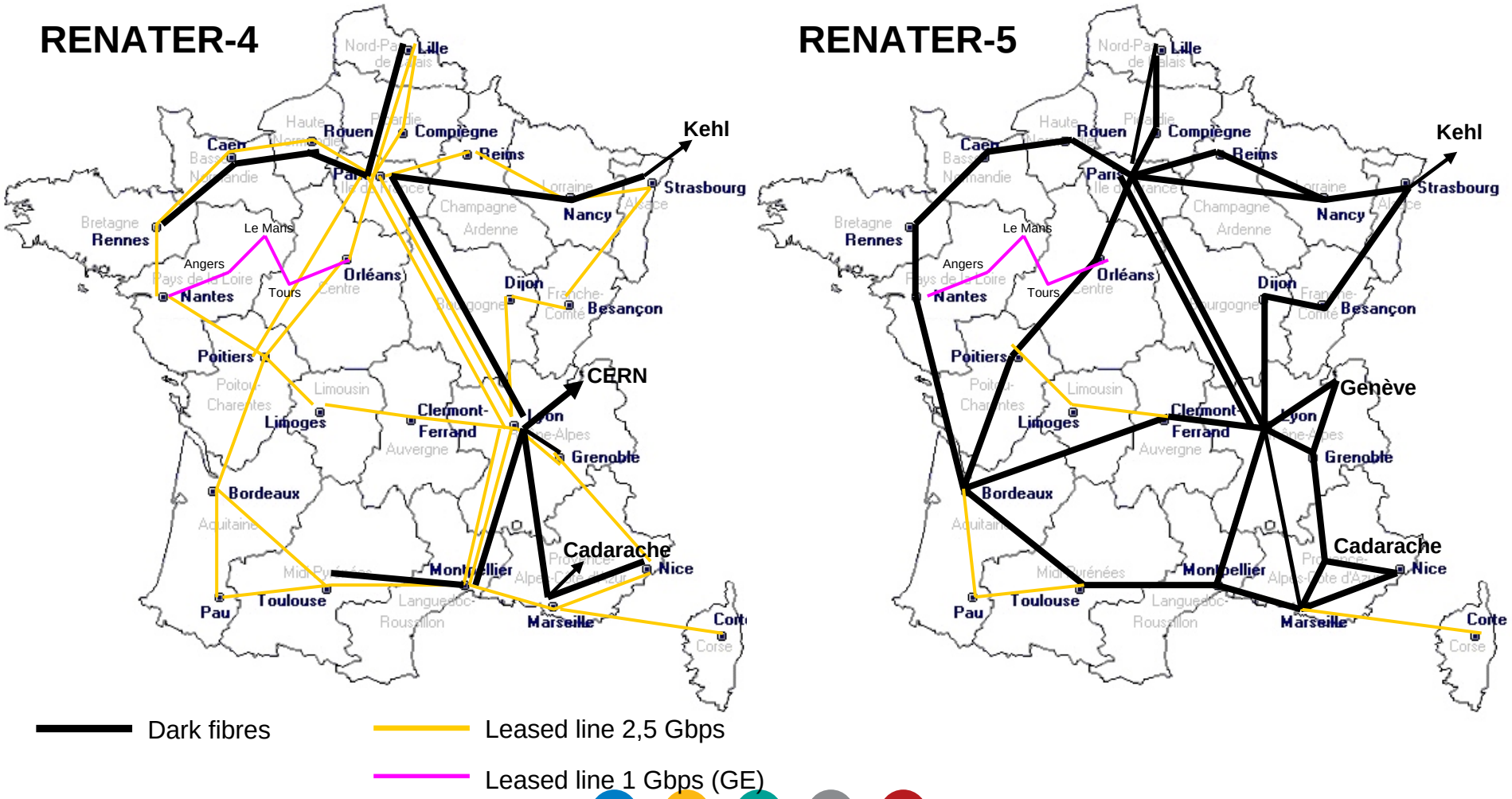
RENATER national backbone



RENATER-5 national backbone

- RENATER-5 phase : rollout completed very beginning of January 2009
- Physical infrastructure
  - More than 7500 km of dark fibres deployed
    - Use of 5 different operators (terrestrial fibres, aerial fibres ...)
    - Fibres rent from operators, using 2 financial models
      - Either long term investments : 10 years IRU
      - Either short term investments : 1 year renting contracts
    - Mainly G652 fibres (but also G655 for a few paths)
    - Redundant fibre path between the core PoPs of Paris and Lyon (2 separate physical end-to-end paths) + redundant core PoPs
    - Make sure no SPOF on physical path when 2 dark fibres are ending on a same PoPs (especially for local loops)
- RENATER-5bis phase ongoing (tender process launched)
  - Get even more dark fibres
    - Setup new paths
    - Try to get dark fibres where it was not possible in the previous tender (because of no offer or at no reasonable price)
    - Try to have optimized prices and get as much as possible IRU when it was not possible before

RENATER-5 DWDM architecture

- Requirements for DWDM architecture
  - Point-to-point lambdas to be activated between RENATER PoPs physically interconnected (distance may vary between 200 km and 150 km)
  - Lambda “express” (long-distance lambdas) for specific research projects (distance up to 1000 km)
  - Need to reduce as much as possible needs for regeneration points (costly)
  - Need to secure some strategic paths at Layer 1

- DWDM design
  - Re-use of DWDM equipment (about 40 chassis) deployed in RENATER-4 phase, but deployment of such equipment on an homogeneous loop to avoid having multiple DWDM vendors on a same path
    - Alcatel 1696MS in shelters for amplification points and Alcatel 1696MS+1626LM (chassis hosting transponders) in RENATER PoPs
  - Decision not to go for ROADMs (too expensive and low added-value for what we needed)
  - Deployment of new DWDM equipment (about 60 chassis) for RENATER-5
    - Metropolitan DWDM equipment : CIENA CN4200
    - Mainly use of “classical” EDFA amplifiers
    - Use of some Raman amplifiers for some amplification PoPs (long spans to be covered with no possibility to have an intermediate shelter to add an amplifier) avoiding to have to implement regeneration points. Spans between 80 and 130 km.
    - Use of tuneable transponders (easier for deployment and one single type of transponder for maintenance)

RENATER-5 DWDM architecture

- DWDM logical infrastructure
  - Point to point lambdas activated between PoPs physically interconnected : such lambdas are extracted onto routers to provide IP services
  - Specific lambdas activated for research projects : such lambdas are extracted onto switches to provide Layer 2 services

  => For most PoPs switch/router chassis rather than switch+router, so that L2 and L3 services may be provided (using trunk on GE interface) on a same end-user port is needed

DWDM usages for research projects

- Examples of lambdas activated for specific research projects:
  - DEISA (Distributed European Infrastructure for Supercomputing Applications)
    - Activation of one 10 Gbps lambda with extension to GEANT
  - LHC (Large Hadron Collider)
    - Activation of one 10 Gbps lambda using the Lyon-Geneva fibre path (+ lambda activated via Lyon-Grenoble-Geneva)
  - GRID-5000/ALADDIN (interconnections of 9 nodes, each one of them hosting several hundred of CPUs – http://www.grid5000.org -)
    - Activation of 10*10 Gbps lambdas for interconnection of GRID-5000 sites
    - Activation of one 10 Gbps lambda with extension to GEANT (DAS-3)

CBF infrastructure

- CBF between France and Germany (operational)
  - Usages :
    - LHC project
      - T0-T1 backup path + T1-T1 traffic
    - Backup GEANT IP access for RENATER and DFN (soon operational)
      - Lambda to be activated between France and Germany to reach GEANT-DE PoP
      - Lambda to be activated between Germany and France to reach GEANT-FR PoP
- CBF between France and Luxembourg (soon operational)
  - Usages :
    - Direct interconnection between RENATER and RESTENA
    - Lambda to be activated for an extension of GRID-5000 project (GRID-5000 site located in Luxembourg)

Evolutions of DWDM architecture

- New design (CIENA based) already validated for up to 40*10 Gbps lambdas for each physical path
- Possibility to activate 40 Gbps lambdas (also up to 40*40 Gbps lambdas)
- 100 Gbps will be supported on existing DWDM equipment
- 40 Gbps/100 Gbps experiments, tests
  - Intensive 40 Gbps (100 GHz DPSK) tests have been done (February 2009) with CIENA equipment
    - Simulation of RENATER Paris-Lyon path
      - Impact of CD, PMD ...
      - Cohabitation of 10 Gbps and 40 Gbps
      - Use of OADMs, ROADMs ...
  - Demo of 100 Gbps
  - 100 Gbps to be commercialized 2011, but expected before to run experiments
- Other experiments
  - Plans to extend experiments to several DWDM vendors + L2 and L3 vendors (and make use of dedicated dark fibres if necessary, to avoid potential impacts onto production traffic)

Questions ?