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DF plans & experiences from Greece

www.seefire.org



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South-East Europe Fibre Infrastructure
for Research and Education

Jorge-A. Sanchez-P.

Greek Research & Technology Network

sanchez at grnet.gr

www.grnet.gr



- GRNET – network infrastructures & Grid infrastructures
- Dark fibre plans & experiences
- Equipment lighting dark fibres plans and experiences



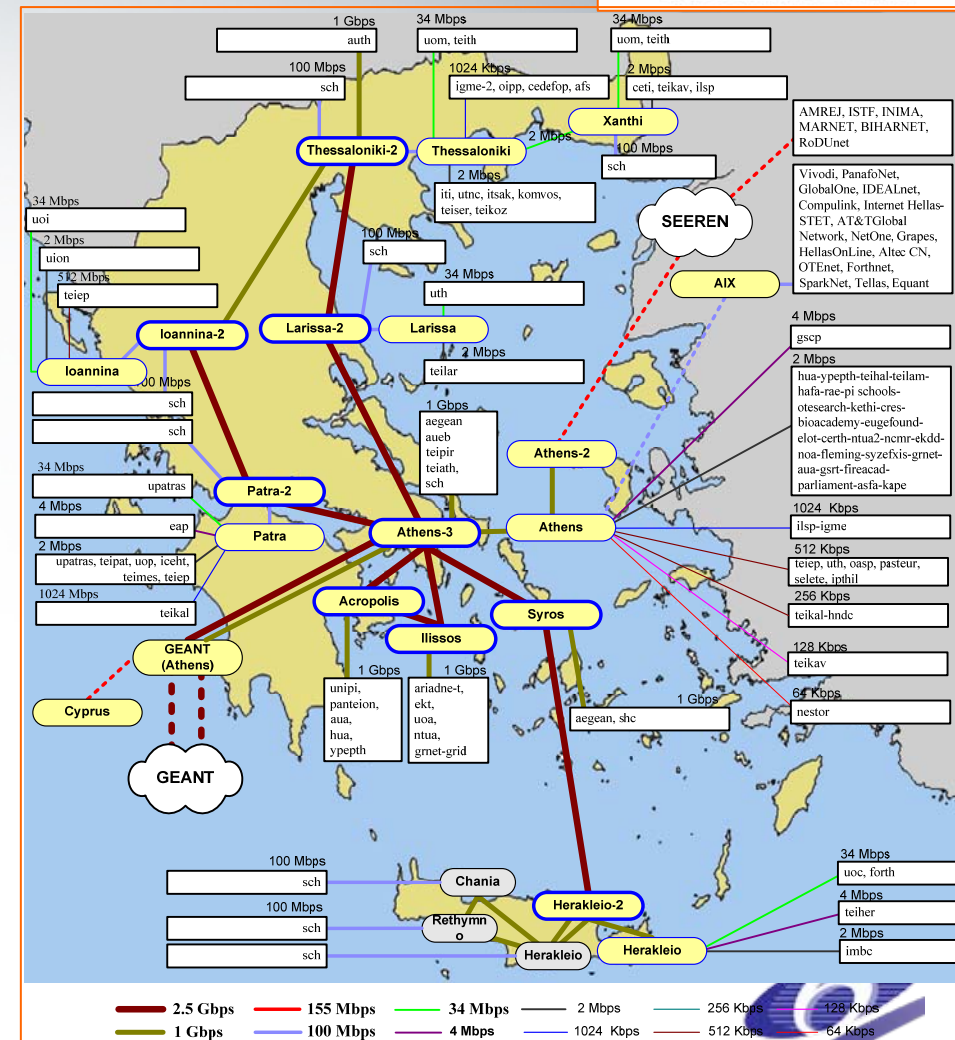
GRNET – Network infrastructure



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- 12-PoP high speed backbone network based on 2.5Gbps leased lambdas and Gigabit routers.
- Interconnects academic and research institutions (more than 80 today) at up to 1Gbps and primary and secondary schools (more than 10.000) at Mbps.
- A total of up to 1.500.000 potential end-users.
- International 2x2.5Gbps (to be upgraded to 2x10Gbps – 3Q05)
- Used the structural funds



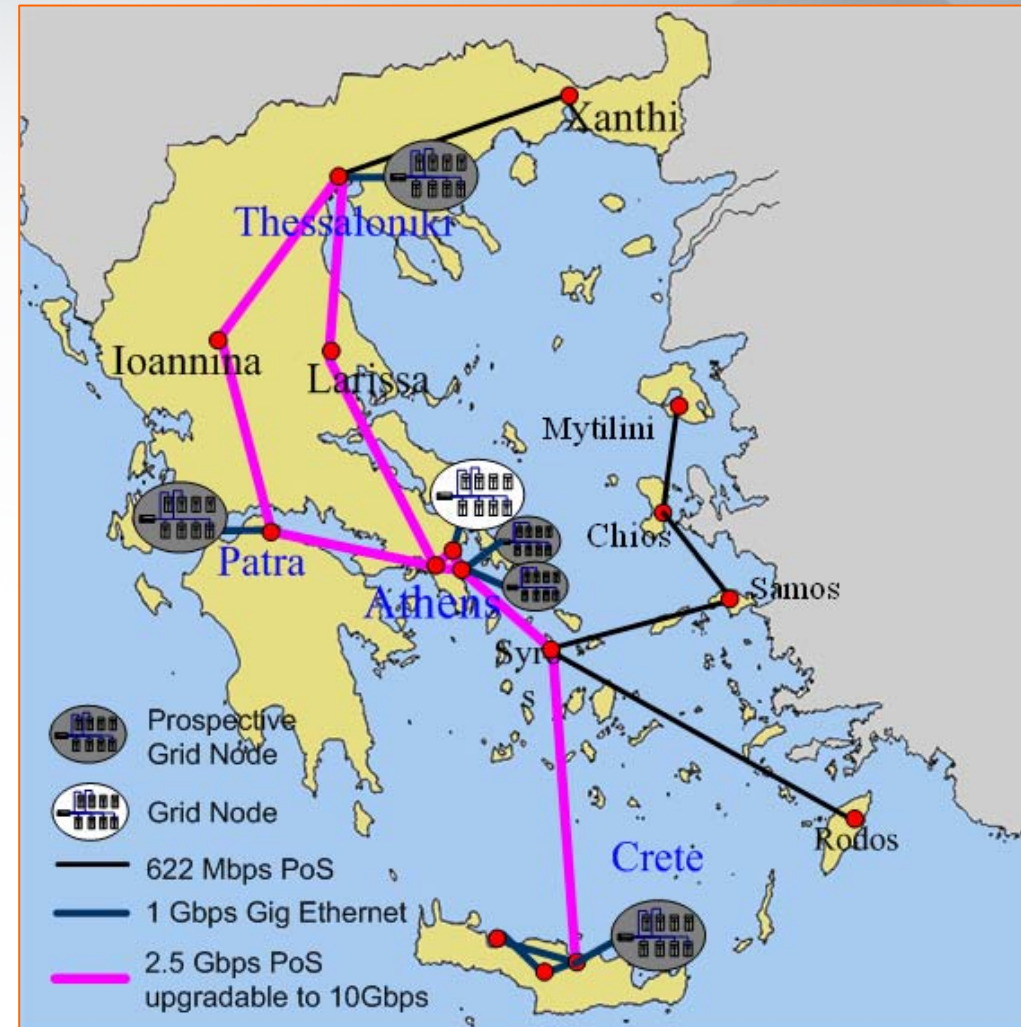
GRNET – Grid infrastructure



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- 6 clusters/sites in deployment (770 CPUs, 34 TBs storage).
- Involves all major research and academic institutes working on Grids-eScience all over Greece.
 - High Energy Physics, Bio-informatics, Meteorology, Astronomy, Computer scientists-Virtual Collaboration Environments
- Providing services to the Pan-European GRID community through the EGEE Project and the SEE community through the SEE-GRID Project.
- **Used the structural funds**





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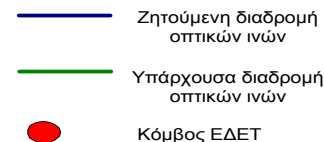
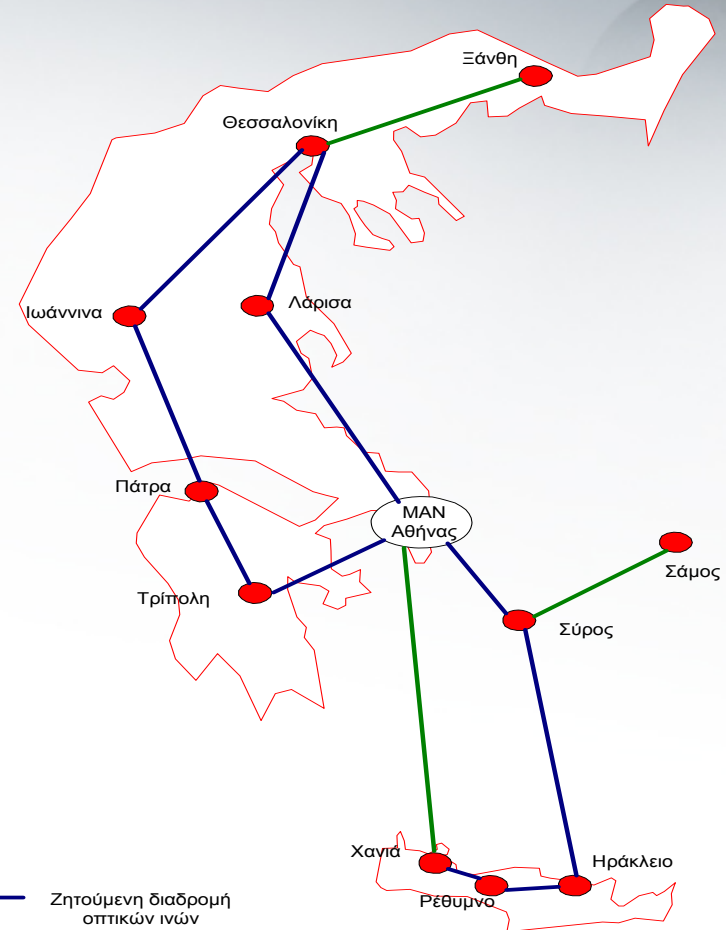
GRNET DF tenders



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- GRNET has published two DF tenders
 - 15-year IRUs, issued in the beginning of 2005 (green links)
 - 20-year IRUS, issued at the end of 2005 (blue links)
- Budget:
 - 15-years IRUs + maintenance : 4ME
 - 20-years IRUs + maintenance : 13,5ME
- Used the structural funds



DF RFP I details



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- Unprotected fiber pairs 10Gbps transmission
 - One terrestrial in northern Greece (Thessaloniki-Xanthi)
 - Two submarine lines in the Aegean Sea (Syros-Samos islands and Athens-Crete)
- Single-mode fiber, preferably G.655 or G.652 c/d.
- 3-6 months for implementation
 - Existing fiber in inter-city parts of the span was a requirement
- Fault terms
 - 3 days for repairing terrestrial fiber in case of cuts
 - 20 days for repairing submarine cuts
- RFP followed by an RFI for transmission equipment



DF RFP I received offers



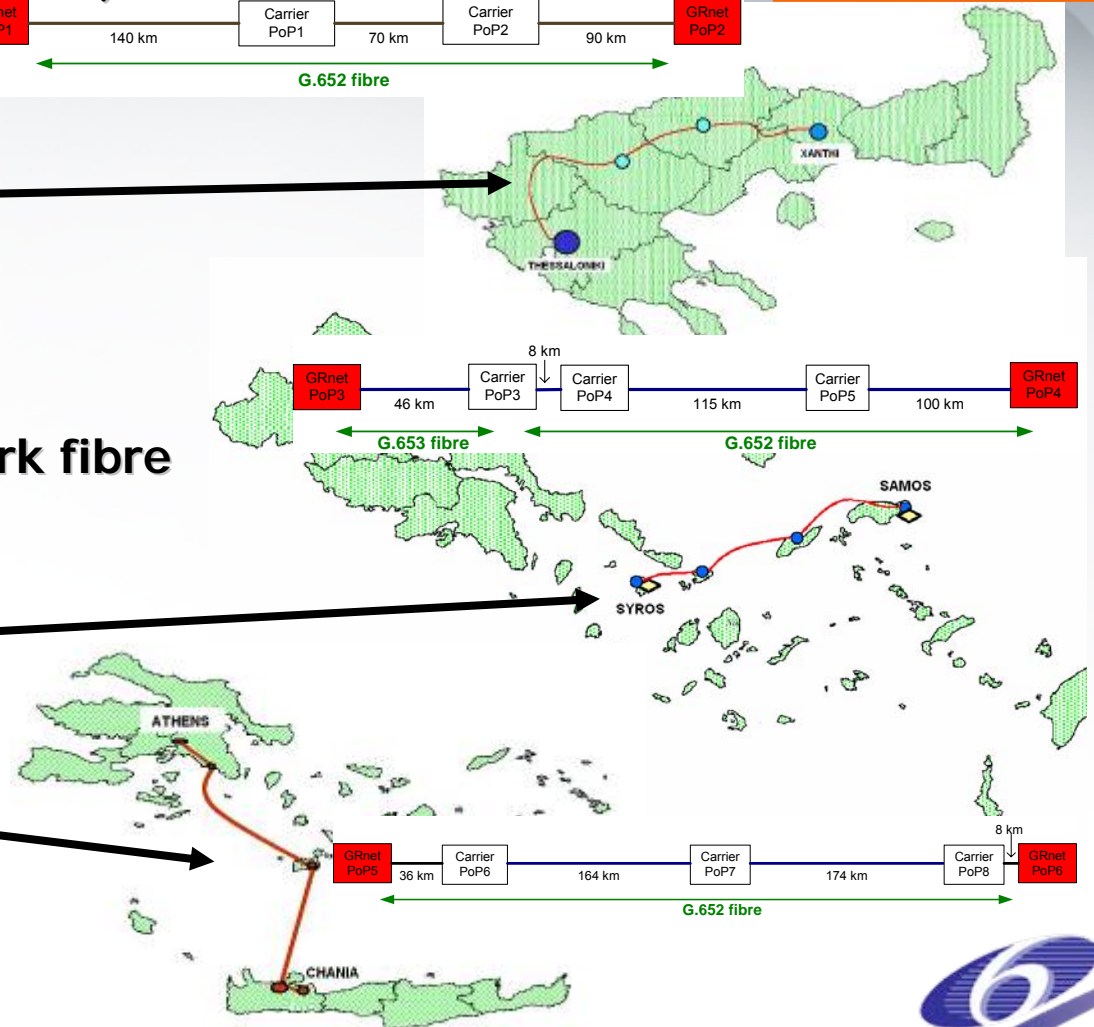
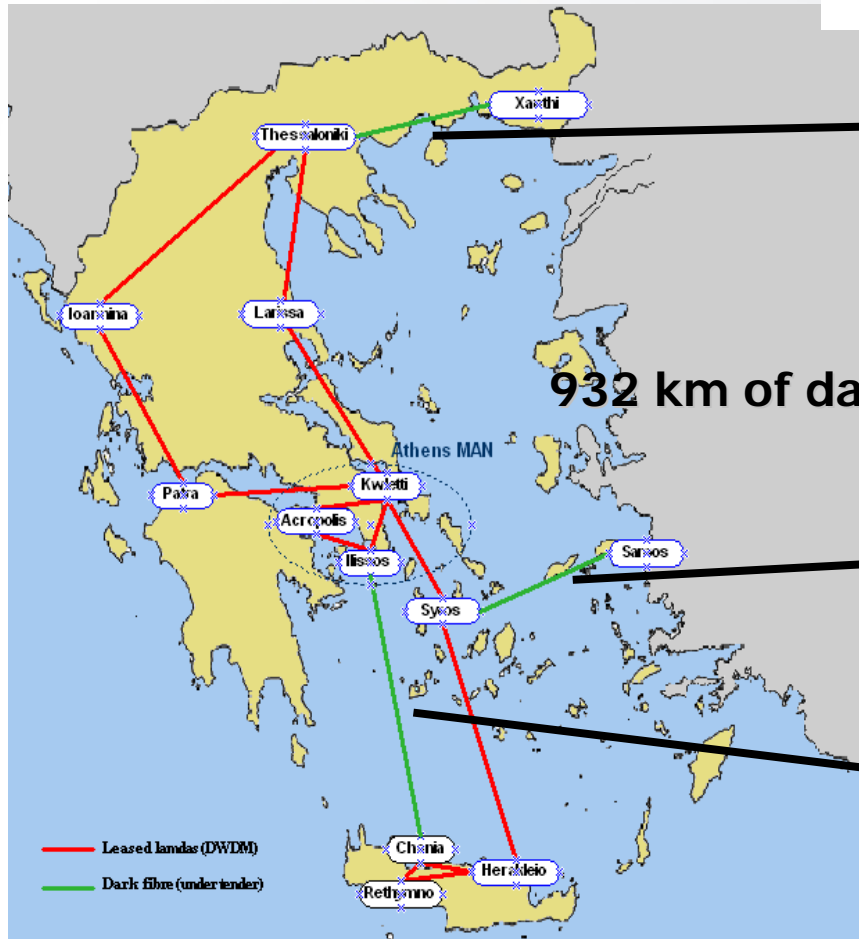
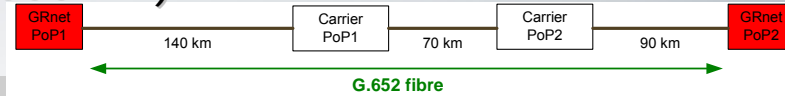
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Attenuation 0.32 dB/Km , 0.25 dB/Km (submarine)

CD G.652 -> 16.5 ps/nm/km (at 1550 nm)

G.653 -> 0 ps/nm/km (at 1550 nm)

PMD 0.050 ps/(Km)^{1/2}



DF RFP II details



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- Collocation at the edges of each span.
- The contractor must not place any active or passive equipment along the fiber span.
- Availability $\geq 99\%$
- The contractor has the obligation to replace existing fiber pair with improved technical characteristics fiber, if this becomes available.
- Price:

15 years IRU (euro/m)	Annual Maintenance
2-2.9	5% * IRU

20 years IRU (euro/m)	Annual Maintenance
2.5-3	3.5% * IRU





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RFI for optical equipment



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- Beginning of 05, issued an RFI for optical transmission and regeneration/ amplification equipment.
- 19 manufacturers responded:
 - Adva
 - AMS-JDS Uniphase
 - BTI Photonics
 - Ciena
 - Cisco
 - Cube Optics
 - Entrada Networks
 - Hitachi
 - Huawei
 - Last Mile
 - Marconi
 - Movaz
 - MRV
 - Meriton
 - Siemens
 - Sorrento Networks
 - Sycamore
 - Transmode
 - Wavium



RFI for optical equipment cont'd



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Type-A Equipment

Client-side

- Gigabit Ethernet from day 1 (mandatory)
- STM-16 (highly desirable)
- STM-4 at the client side (optional)
- 10 Gigabit Ethernet at the client side (optional)

Transmission-side:

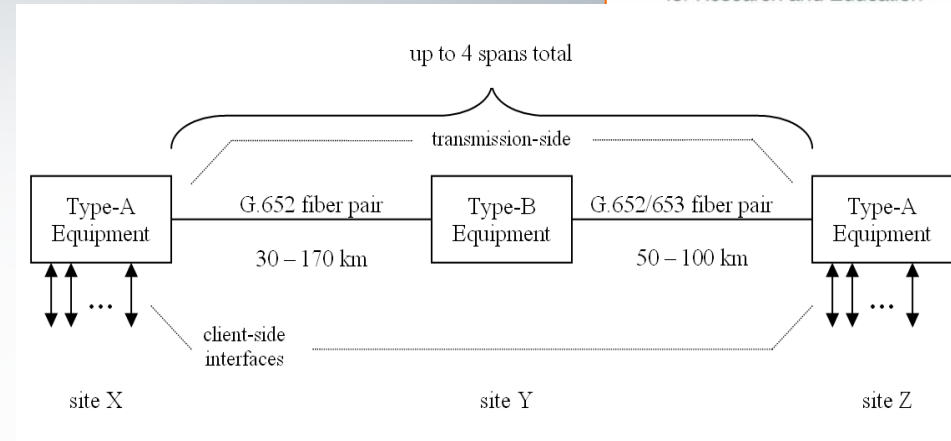
- Aggregate capacity of at least 1Gbps from day 1 upgradeable to $N \times 2,5$ Gbps (mandatory) or $N \times 10$ Gbps (desirable), with $N \geq 1$.
- Support of bidirectional use of a single fiber at the transmission side (highly desirable).

Type-B Equipment

Optical signal "expansion" (mandatory)

- Optical-Electrical-Optical (OEO) - Regeneration
- Amplifiers (e.g. EDFA, SOA) coupled with appropriate dispersion compensation modules.

Support of bidirectional use of a single fiber (highly desirable).





RFI for optical equipment - Responses

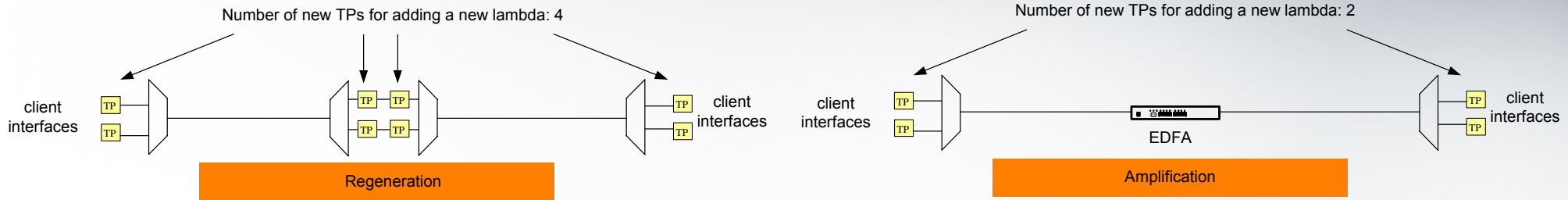
- Loss budget for xWDM transponders ranges from 24-30db.
- By using preamplifiers and boosters a 45 db span can be implemented.
- Terminal equipment supports pluggable CWDM or DWDM transponders.
- Most manufacturers support multi-rate transponders
 - Client interfaces' protocol/rate is manually configured.
 - No frame size limit.
- A great number of manufacturers support line cards muxing 2x1GbE to SDH STM-16 framing.
- Bidirectional use of fiber inserts attenuation and limits maximum spans length.



Regeneration or Amplification?



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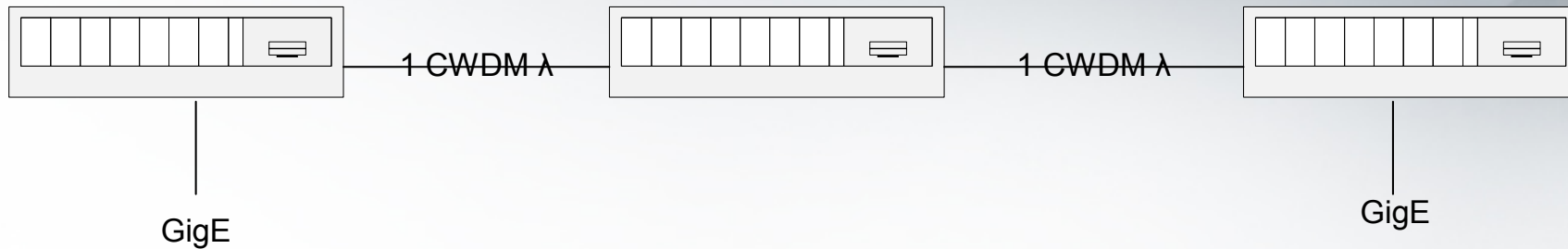
- Regeneration is cost-effective when a limited number of lambdas is deployed. As the number of deployed lambdas increases amplification is by far the most cost-effective solution.



RFI for optical equipment - Cost



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- Price for implementing a 2-span single CWDM λ link starts from 30.000 euros.
- Price for DWDM transponders starts from 8.000 euros
- Price for CWDM transponders starts from 4.000 euros
- Price for EDFAs range among 15.000-40.000 euros.



CWDM or DWDM?



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- Price difference among same manufacturer's CWDM and DWDM transponders ranges from 20 to 50%.
- However CWDM is not a scalable solution for backbone links; EDFAs cannot amplify more than 2 CWDM lambdas.



RFP for optical equipment



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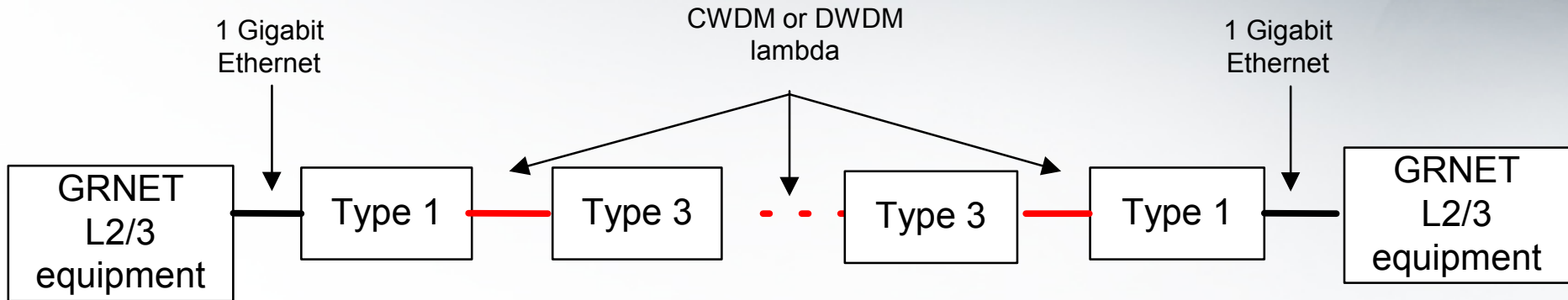
- Issued on September 05.
 - Offers opened on the 21st of November
 - Budget 375KE.
- Types of equipment
 - Type 1: Terminal equipment
 - Type 2: Lambda add/drop equipment
 - Type 3: Regeneration/amplification equipment



Minimum requirements



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- At least one e2e CWDM or DWDM lambda framed as 1 GbE
- Scalability: up to 8 lambdas
- “Smooth” addition of new lambdas

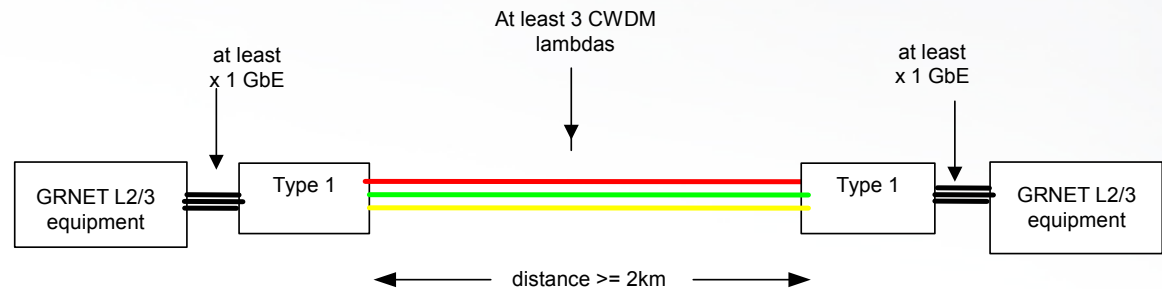


Other requirements



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- 3R
- Client interfaces must support 1GbE through either
 - Transparent transponders or
 - Transponders that mux 2x1GbE signal to an STM-16 framed lambda.
- Jumbo frames support is a must
- Line interfaces:
 - ITU-T CWDM/DWDM lambdas
 - ITU-T G.709 support
 - SFP MSA support
 - SFF 8472 support
- SNMP support
- Serial/telnet/ssh access
- EMS and NMS (optional)
- Testbed implementation
- Training to GRNET personnel
- 3-years support
- Next business day replacement of faulty equipment



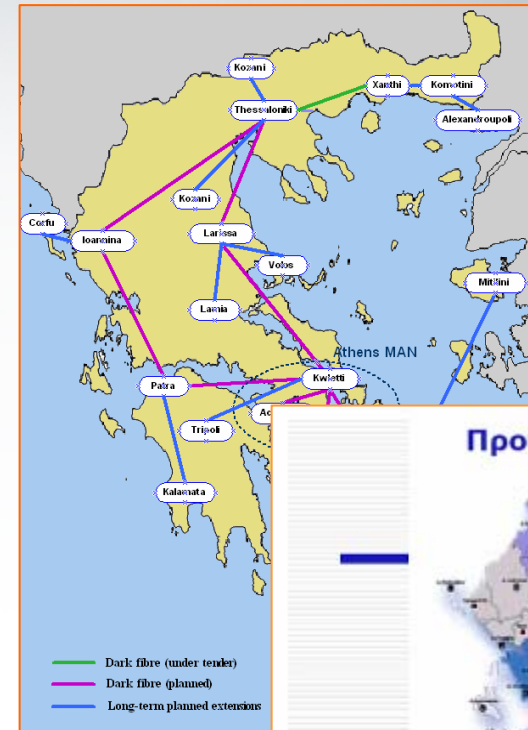
Dark fibre plans (2006+)



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- The whole of the GRNET backbone is planned to be implemented using dark fibre pairs obtained via long-term IRUs.
- Dark fibre for local loops to all major academic institutions are currently being acquired via a structural funds project (**Using the structural funds**)
- Development of fiber rings at Greek municipalities
 - Fiber rings will connect public administration offices, hospitals, universities and telehouses.
 - **Used the structural funds**: 54ME
 - Municipalities will provide IRUs to companies for private use. Charging will be cost-based.
 - Most metropolitan networks are expected to be ready by the end of 2006.
 - GRNET will greatly benefit from Metropolitan networks
- Actions for obtaining dark fibre towards the northern part of Greece, in an attempt to establish cross border fibre links with neighbouring countries, are also planned.





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