GARR-X phase 0

GARR network status

GARR-X project updates

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GARR User Community
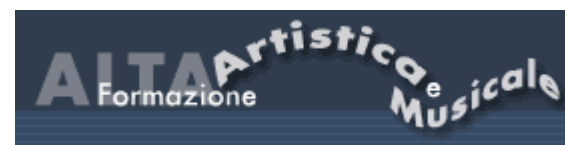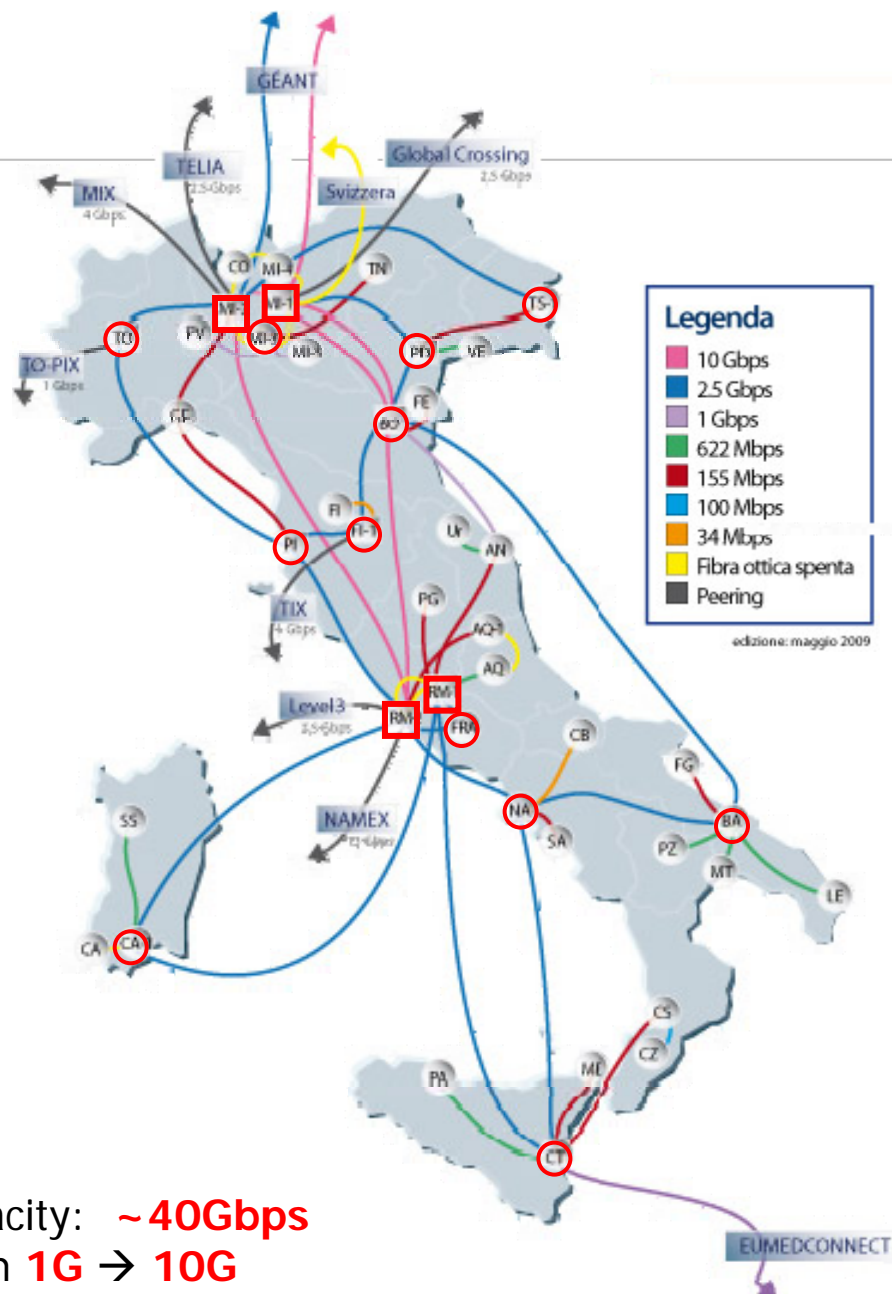
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GARR Network

- **43 POPs** (University and Research Centre)
- PEERING: **76 Gbps**
  - **52.5Gbps** vs GEANT2
    - 10G + 2.5G IP Access
    - 3*10GE E2E links
    - 9*1GE E2E links
  - **3x2.5Gbps** IP Transit
    - 2 Milan + 1 Rome
  - **7x1Gbps+10Gbps** National PEERING
- BackBone Capacity ~**110Gbps**
- **7 TLC Operators**
  - Telecom Italia
  - Infracom (ex Autostrade TLC)
  - Fastweb
  - Interoute (ex Eurostrada)
  - WIND
  - BT-Italia (ex Albacom)
  - COLT-Telecom
- **3 International IP Carrier**
  - Global Crossing
  - Telia
  - Level3
- Access Capacity: ~**60Gbps**
  - Starting from **2M → 10G**
  - N.Access Links: **500**
  - N.Backbone Links: **62**

- E2E Capacity: ~**40Gbps**
  - from **1G → 10G**

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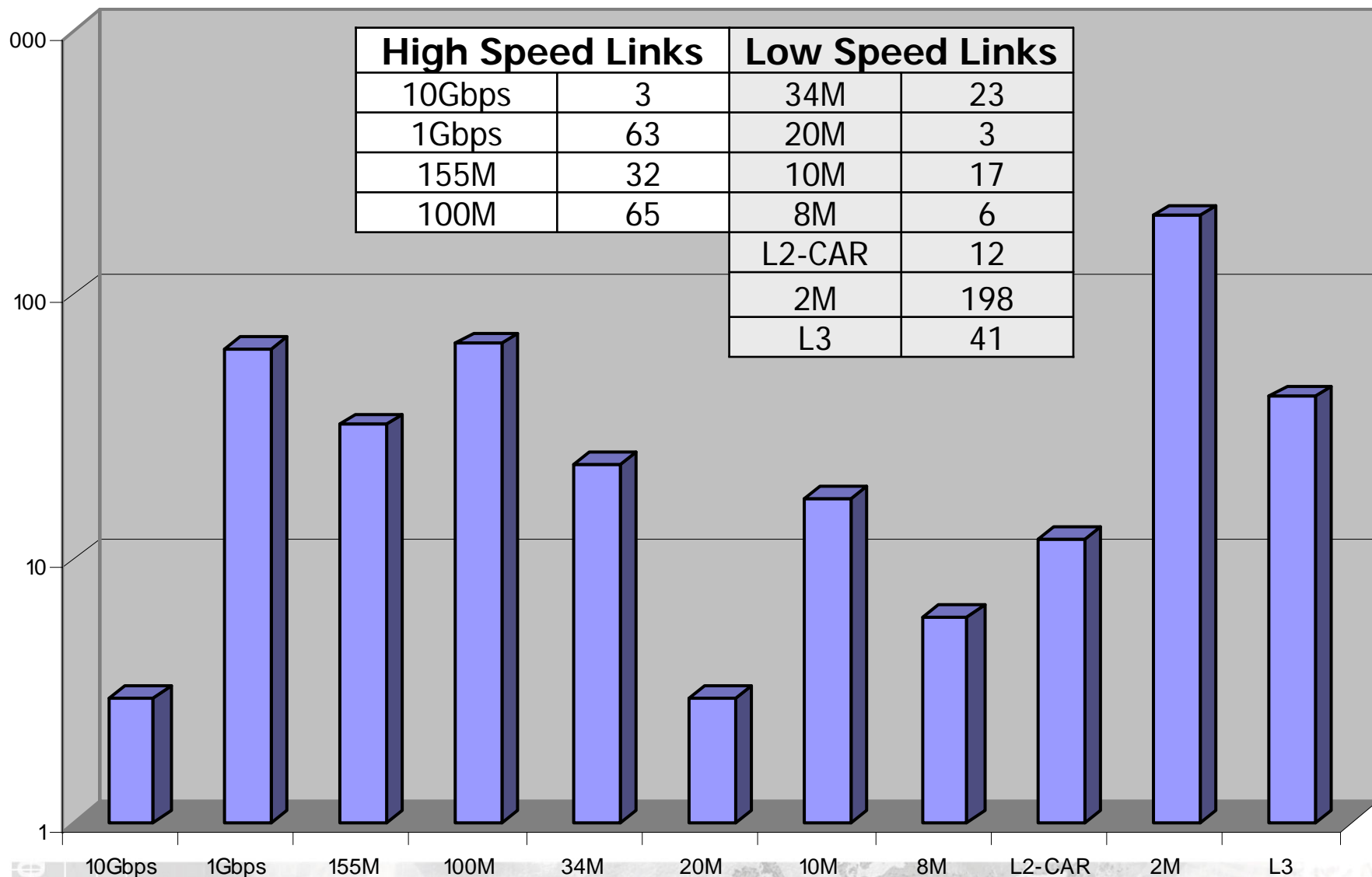
Legenda
- 10 Gbps
- 2.5 Gbps
- 1 Gbps
- 622 Mbps
- 155 Mbps
- 100 Mbps
- 34 Mbps
- Fibra ottica spenta
- Peering

edizione: maggio 2009

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GARR User's Access Capacity

High Speed Links		Low Speed Links	
10Gbps	3	34M	23
1Gbps	63	20M	3
155M	32	10M	17
100M	65	8M	6
		L2-CAR	12
		2M	198
		L3	41

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GARR Traffic Trends

30.67 Gbps

3.84 Gbps

Legend:
- Ave In
- Ave Out
- Max In
- Max Out
- Vol In (Pbps)
- Vol Out(Pbps)
- 95th In
- 95th Out
- 95th

Y-axis: 35 Gbps, 30, 25, 20, 15, 10, 5, 0

X-axis: 1/2005, 5/2005, 9/2005, 1/2006, 5/2006, 9/2006, 1/2007, 5/2007, 9/2007, 1/2008, 5/2008, 9/2008, 1/2009, 5/2009
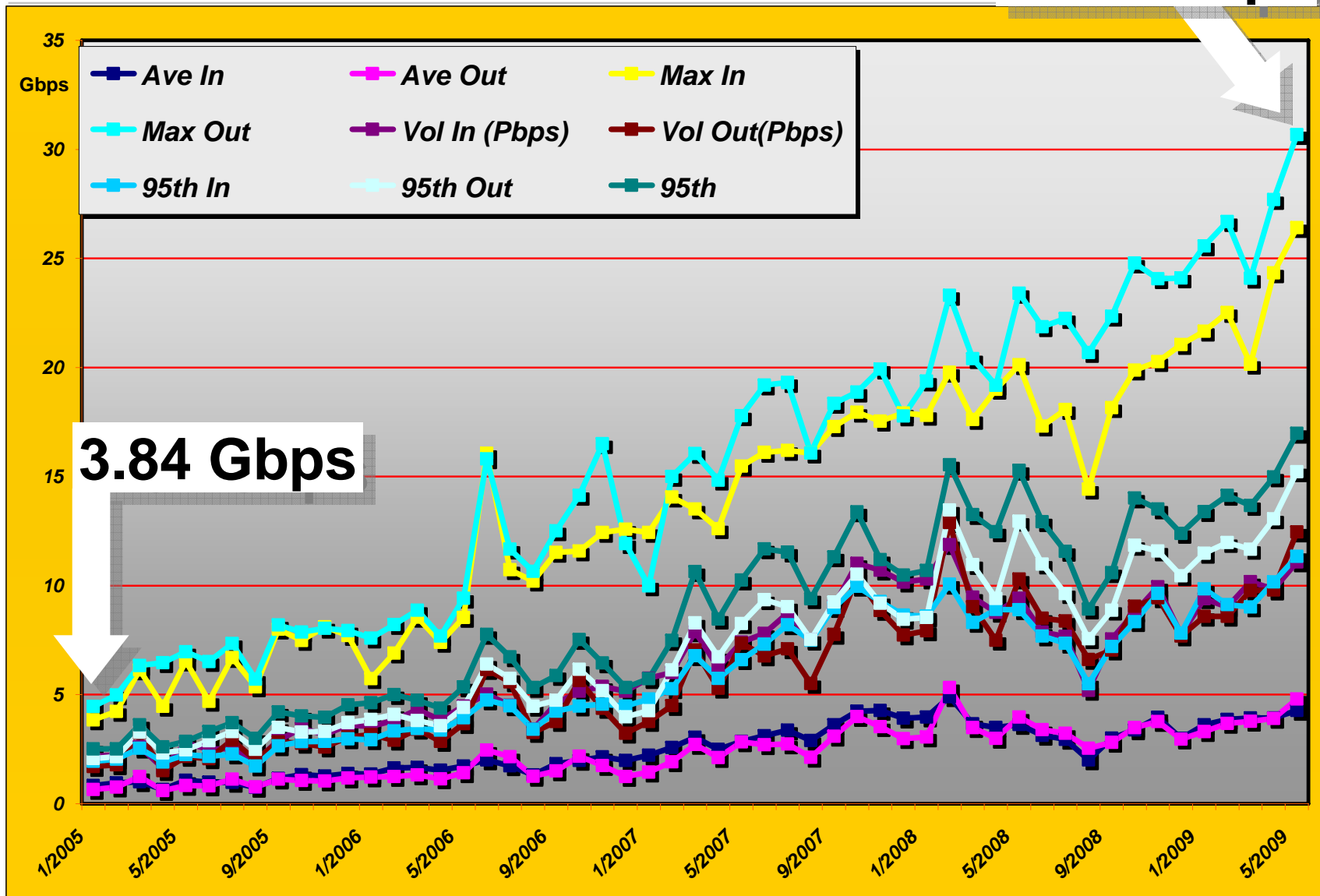
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Global Traffic Trend (→ 1/1/2005)

$$y = 39.424x + 339.44$$

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Traffic Evolution

GLOBAL INTERNET   r ~ 1.4/y

NATIONAL INTERNET   r ~ 1.6/y

RESEARCH TRAFFIC   r ~ 2.0/y

E2E

2001   2002   2003   2004   2005   2006   2007   2008   2009   6/22

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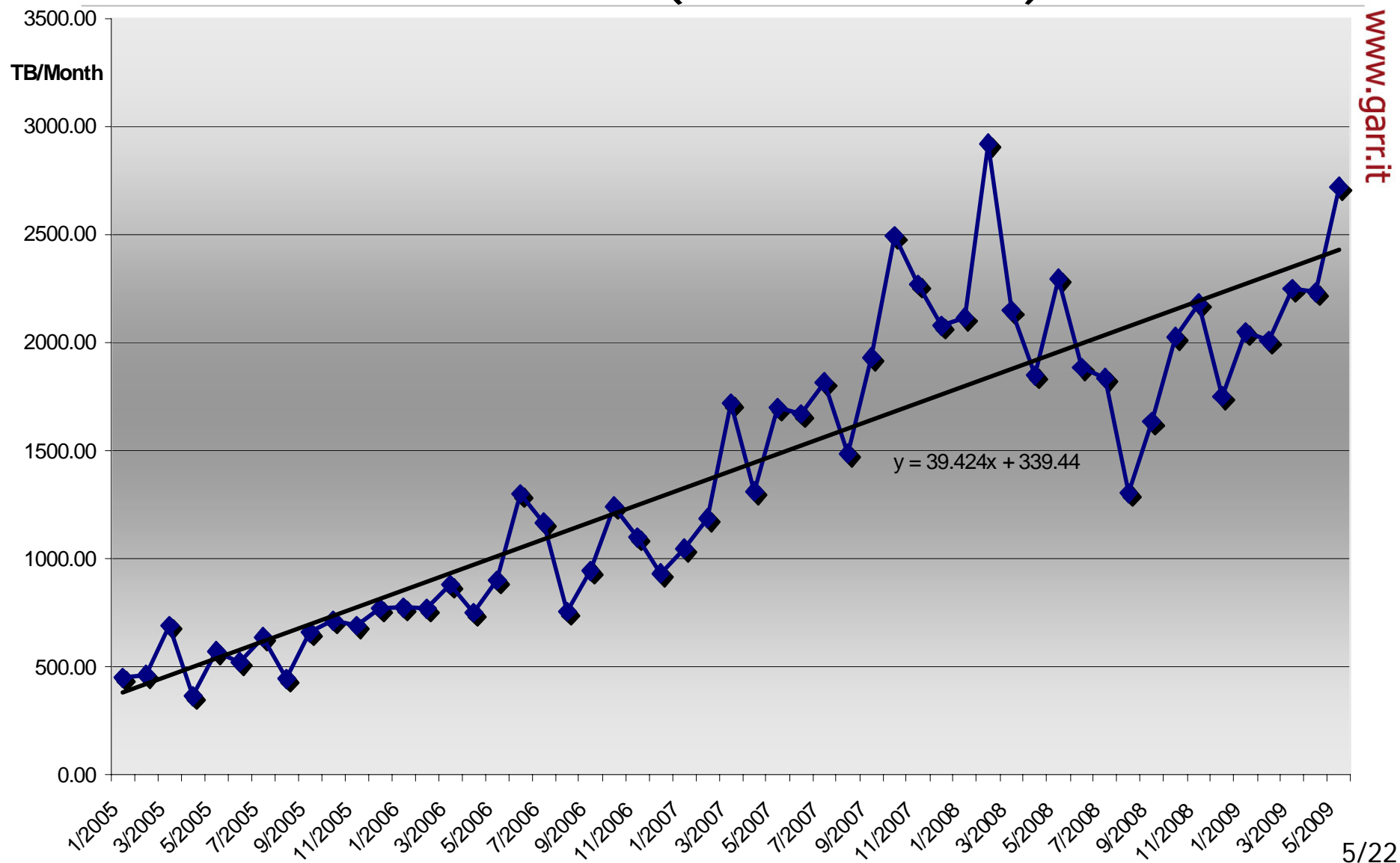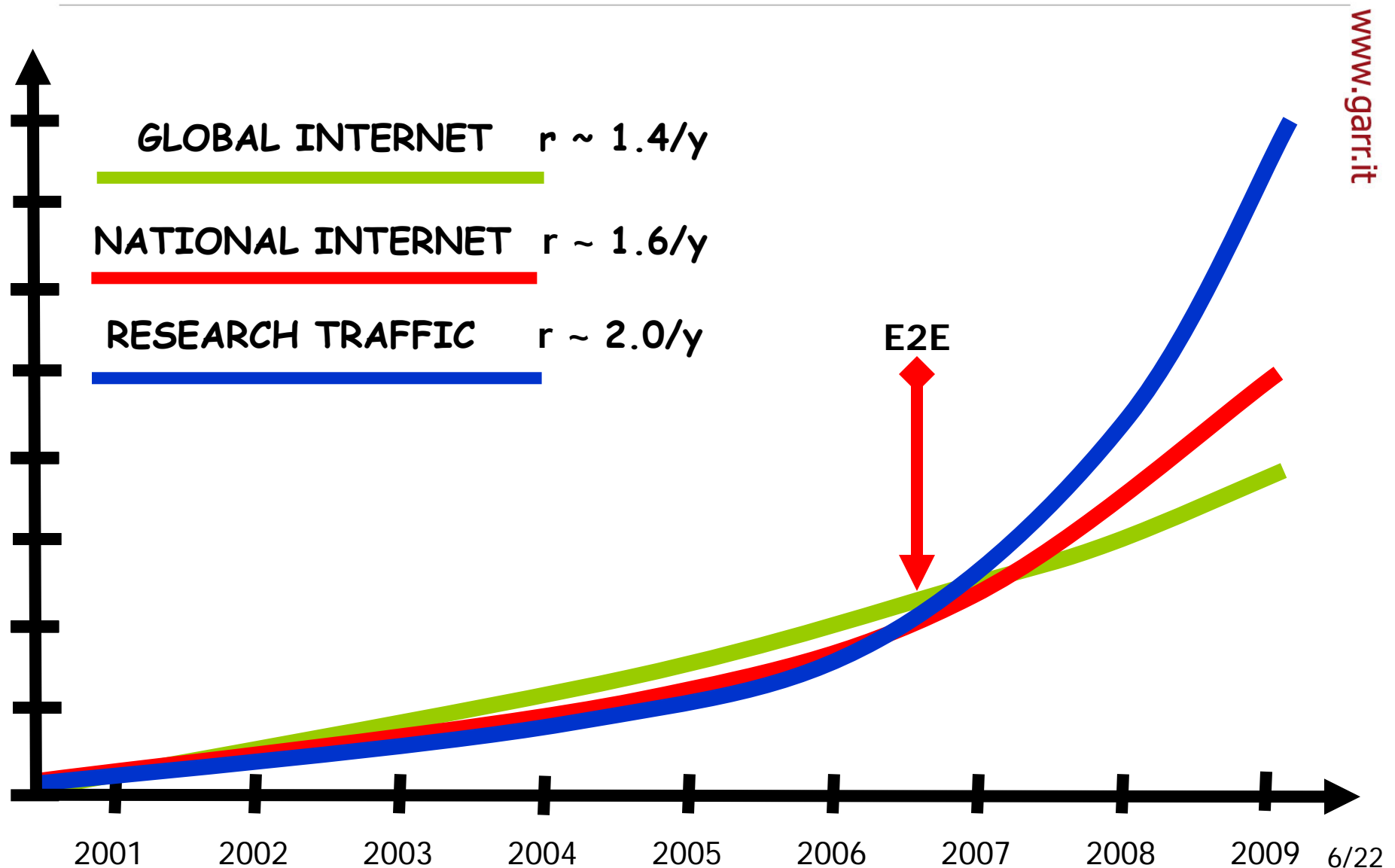
From GARR-G to GARR-X

- From GARR-G to GARR-X
  - GARR-X is the Project for the GARR network evolution in the next (at least) 6 years
  - The GARR-X network implementation starts at the end of this year (GARR-X Phase 0)
  - The transition from GARR-G network to the new infrastructure will take place through a continuous process
- Why GARR-X?
  - Increasing the flexibility and the efficiency of the technical and economic model of the network
  - Keeping pace with user requirements
  - Providing the same services everywhere in the country

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The key evolution factors

- Long term leasing of optical fibres (both for backbone and access) under the exclusive control of GARR

- Acquiring and installing new generation equipments (router and photonic)
  - High level of reconfiguration
  - Multi lambda capacity on the same fibre pair (**10Gbit/s**, **40Gbit/s** ➜ **100Gbit/s** when available)

- The direct control and management of the whole network infrastructure (today only at IP level)

The GARR-X network characteristics

- Low incremental costs for the network infrastructure evolution (after the first bulk investment)
- Flexibility to satisfy the (present and future) users requirements
  - Implementing dedicated networks on GARR-X infrastructure for special groups of users in order to support specific services or applications
- Integration with extended Campus LAN, MAN and RAN
- Low cost and high bandwidth guaranteed access to the network
  - FastEthernet, 1Gigabit and 10Gigabit Ethernet on
    - Optical fibre (preferred solution ≥ 1Gbit/s)
    - Direct circuit by telco operators (<1Gbit/s)
    - Circuits aggregations by means of telco operators network (<100Mbit/s)

The fibre based interconnections to other NRENs
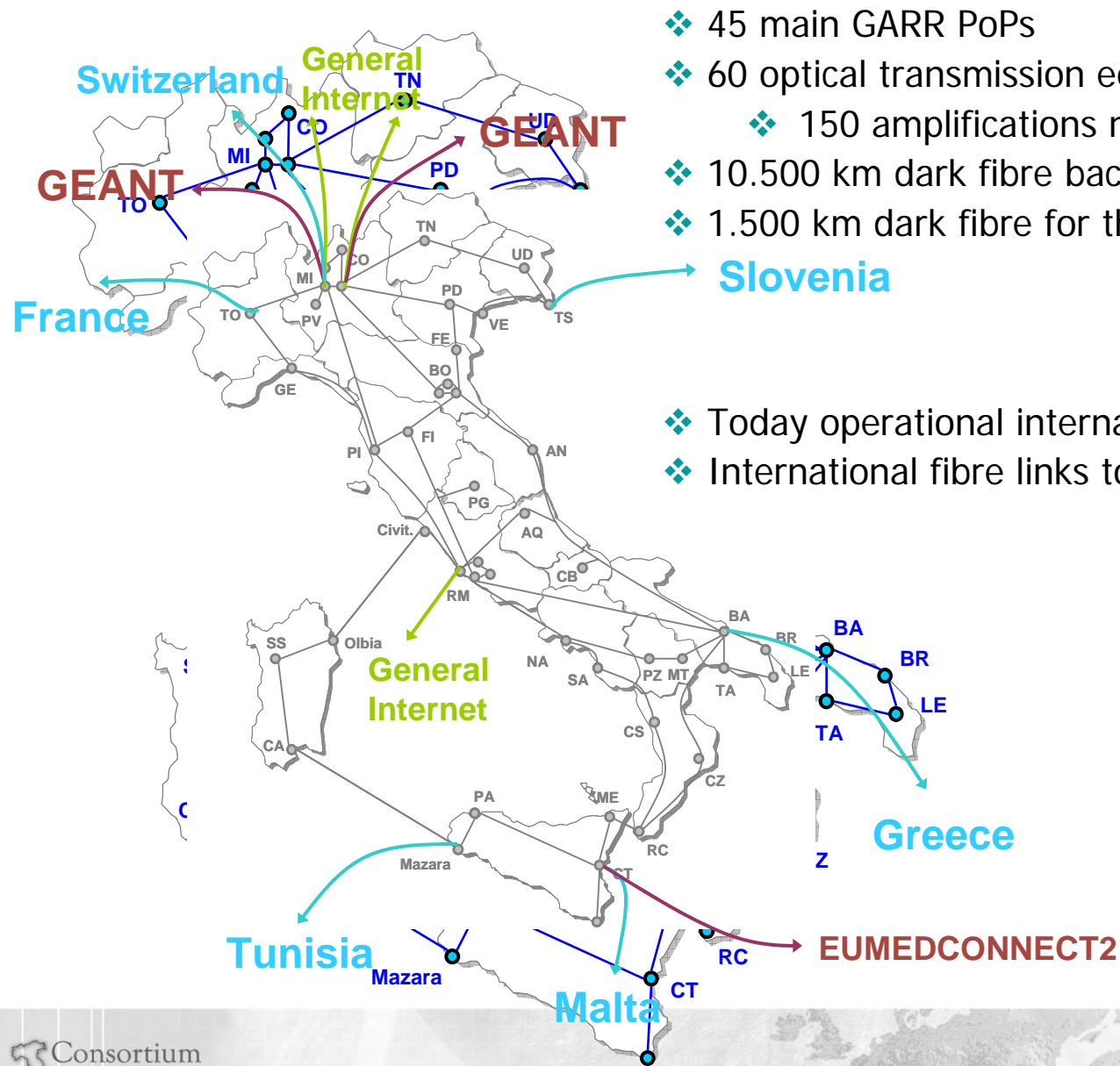
- ❖ 45 main GARR PoPs
- ❖ 60 optical transmission equipments
  - ❖ 150 amplifications nodes
- ❖ 10.500 km dark fibre backbone
- ❖ 1.500 km dark fibre for the access

- ❖ Today operational international fibre links
- ❖ International fibre links to be implemented in GARR-X

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The users' benefits

- Higher network access capacity
  - The aggregate network access capacity will raise of about 50% in the first year and four times in 6 years

- Better performances
  - Reduced delay and jitter for the Real-time applications
  - Reduced time for faults detection and resolution

- New services
  - Dedicated end-to-end circuits on the whole country
  - Bandwidth on-demand
  - Optical private networks and L2/L3 MPLS VPN
  - Storage and Local Area Network Extension (Disaster Recovery applications)
- ... also extended to international multi domain level

- Improve and extend the user applications support
  - Grid and Cloud Computing
  - Telemedicine
  - E-learning
  - Multimedia content access (Museums, Libraries, Music Conservatories, Public record offices)
  - Voice over IP (VoIP)

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INAF Radio astronomy OPN (eVLBI project)
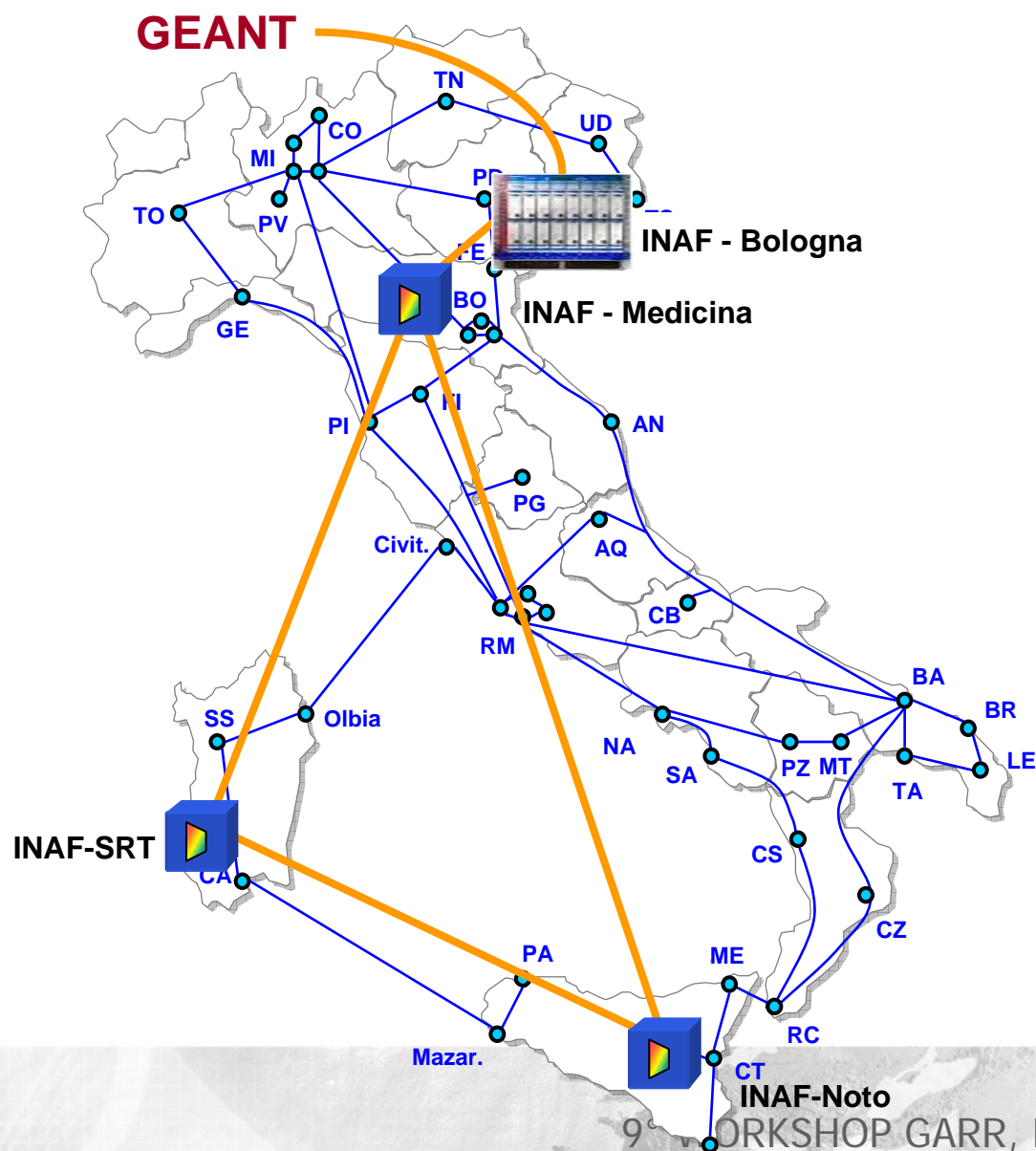
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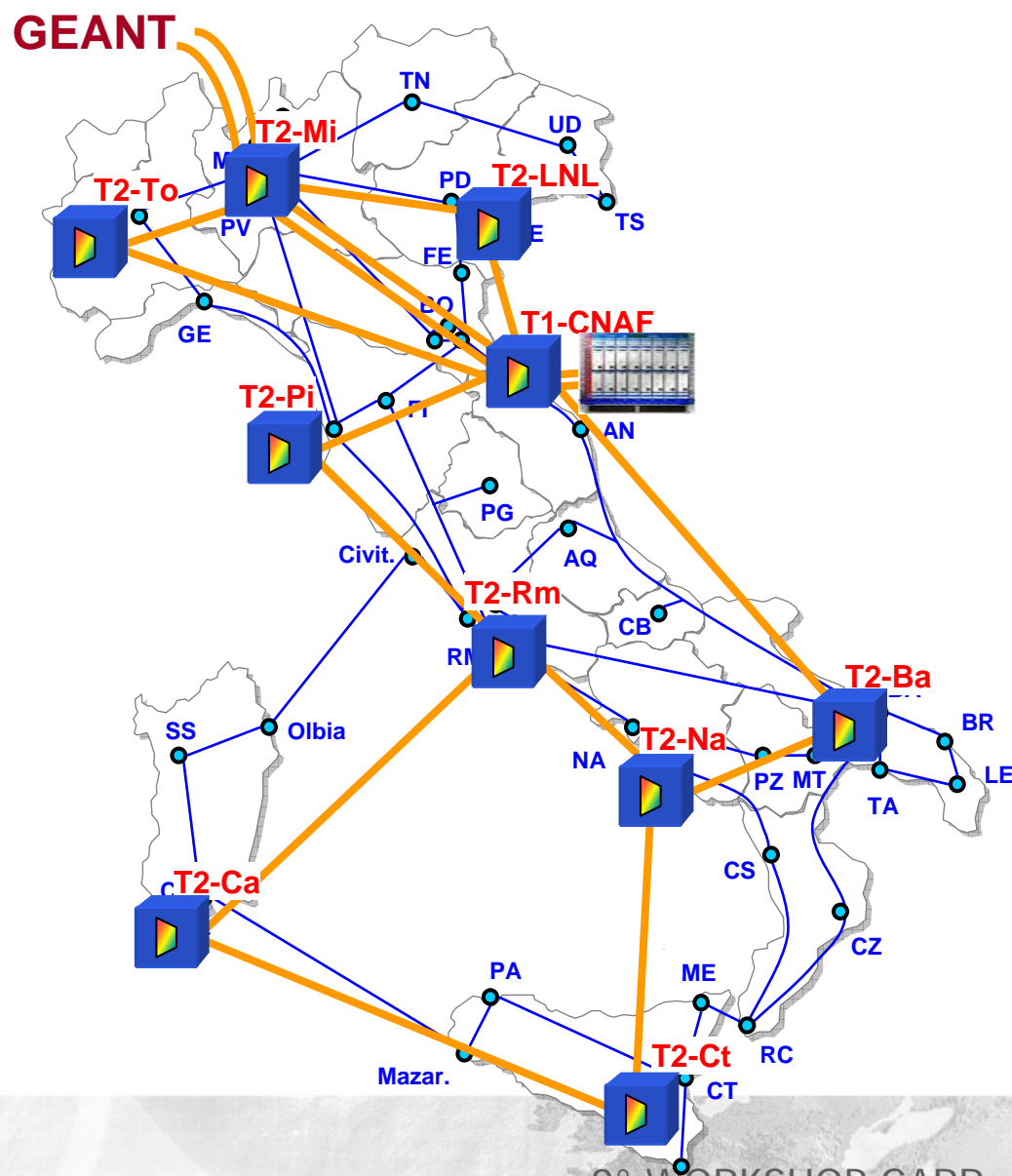
OPN of GRID Projects in the south of Italy
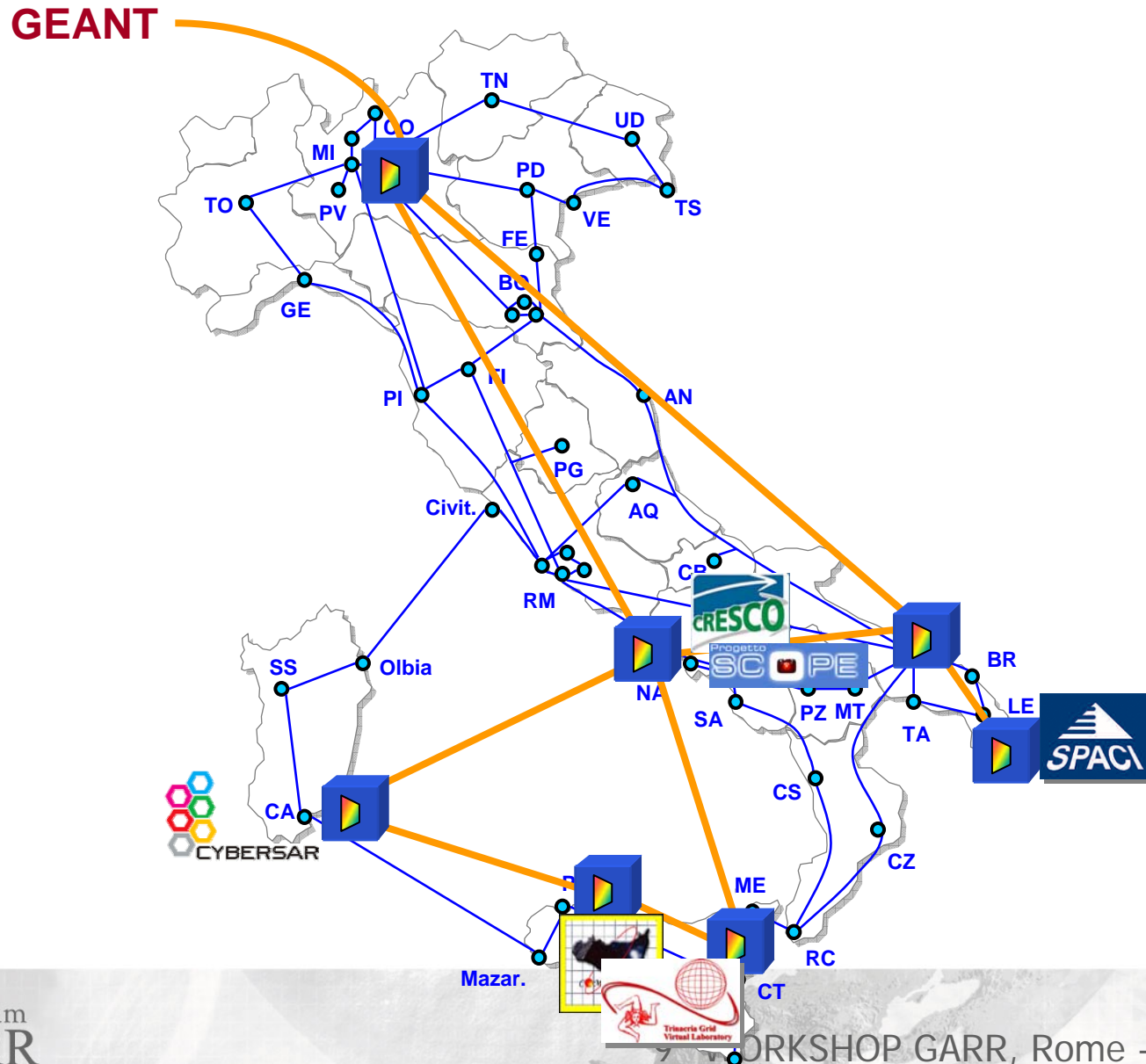
13/22

INFN T1-T2 national OPN (LHC project)

GARR-X phase 0
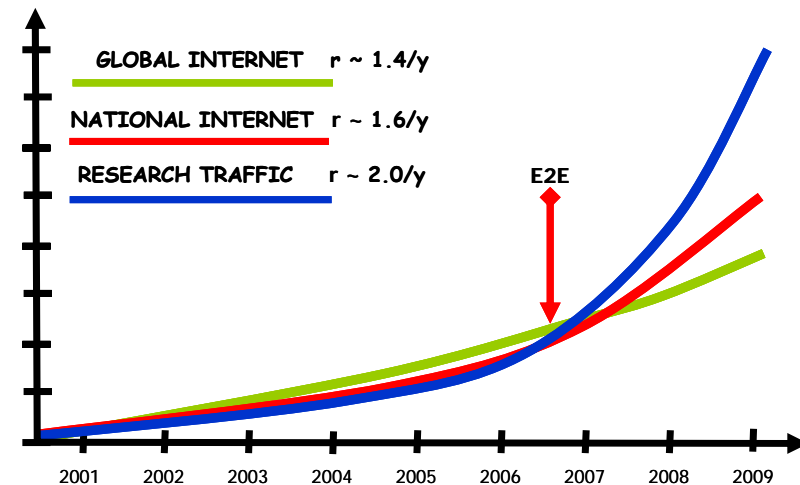
GARR   network status

GARR-X project updates

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GARR-X Phase 0: goals

- Total network bandwidth evolution
  - Initial increase factor of backbone capacity
    - IP: ≥ 2 (~ 8 in 3 years)
    - end-to-end circuits : 2 (~10 in 3 years)
  - Initial increase factor of access capacity
    - 1,5 (~4 in 6 years)
- Keeping below the today value the global network expenditure per year

GLOBAL INTERNET   r ~ 1.4/y
NATIONAL INTERNET   r ~ 1.6/y
RESEARCH TRAFFIC   r ~ 2.0/y   E2E

2001 2002 2003 2004 2005 2006 2007 2008 2009

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Design criteria

- Empowering the backbone
  - leasing optical fibers along the higher traffic lines and between the points of major traffic aggregation, instead of leasing telco operators circuits
- Pushing the optical fiber adoption for the user sites access to the network
  - PRO: unlimited access bandwidth potentiality
  - CONTRA: possible decreasing of SLA
    - → in the time to repair due to fiber cut
- Large adoption of low bandwidth (<100Mbps) circuits aggregation through telco operators MPLS/VPN services
  - PRO: low cost
  - CONTRA: reduced bandwidth evolution (<100M) and advanced services provision
- lambda multiplexing on dark fibers by means DWDM equipments
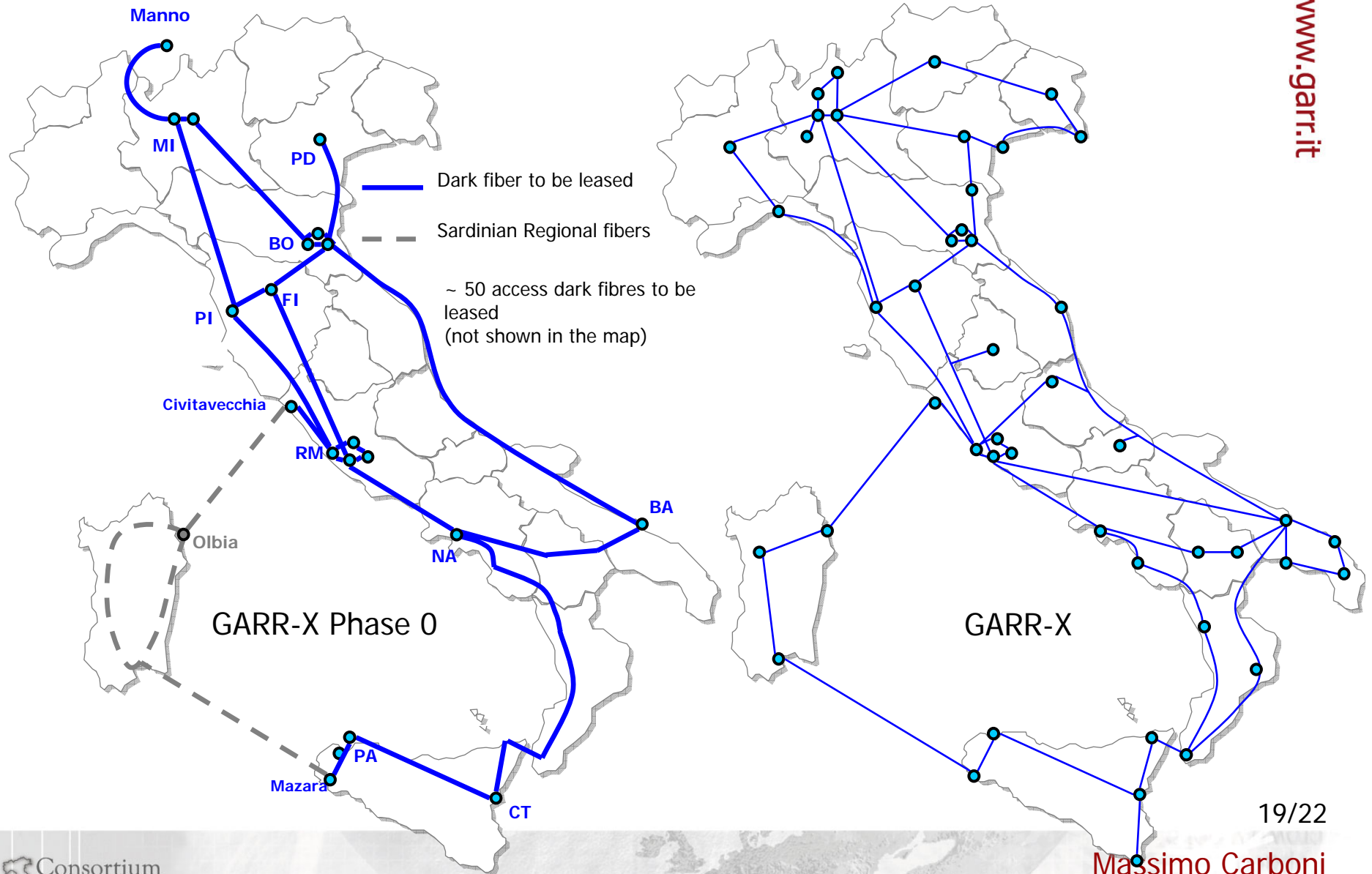
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GARR-X Phase 0: procurement procedures

1. Tender to lease **dark fibers** (backbone and access) for 6 years, including maintenance service and housing for amplification nodes

2. Tender to lease Telco operators **circuits** for 3 years, if dark fiber is not available or too expensive

   - different technology circuits (lambda, SDH and low capacity xDSL access)

3. Tender for **DWDM equipments** to manage and operates lambdas on the leased dark fiber, including maintenance service for 6 years

4. Tender for core and access **routers**, including maintenance service for 5 years
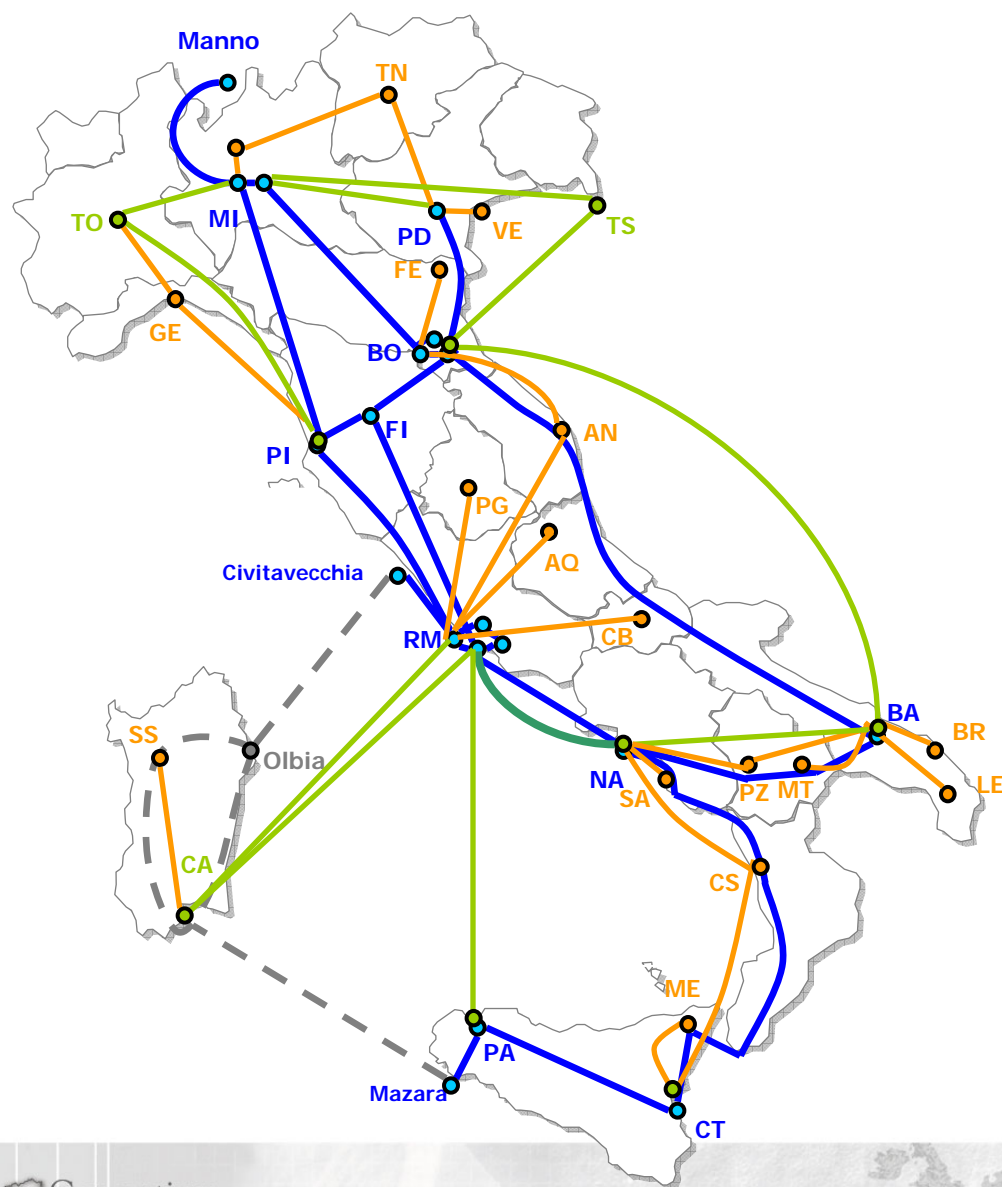
GARR-X-phase0: the dark fiber backbone topology

Dark fiber to be leased

Sardinian Regional fibers

~ 50 access dark fibres to be leased
(not shown in the map)

GARR-X Phase 0

GARR-X

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GARR-X Phase 0: circuits topology for the backbone

Legend:
- Dark fiber to be leased
- Sardinian Regional fibers
- 10Gbps
- 2.5Gbps
- 1Gbps

- ❖ ~ 50 access dark fibres o be leased
- ❖ ~ 80 access circuits to be leased
- ❖ ~ 180 xDSL access circuits
  - ❖ (not shown in the map)

- ❖ ~ 20 transmission node
  - ❖ Long distance, metro
    - ❖ Up to 9 lambdas for fibre section
- ❖ ~ 20 new routers
  - ❖ 4 core routers
  - ❖ Access router (2Mbps÷10Gbps)

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GARR-X Phase 0:
IP network topology

10Gbps

2.5G Gbps

by Maurizio Scarpa

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21/22

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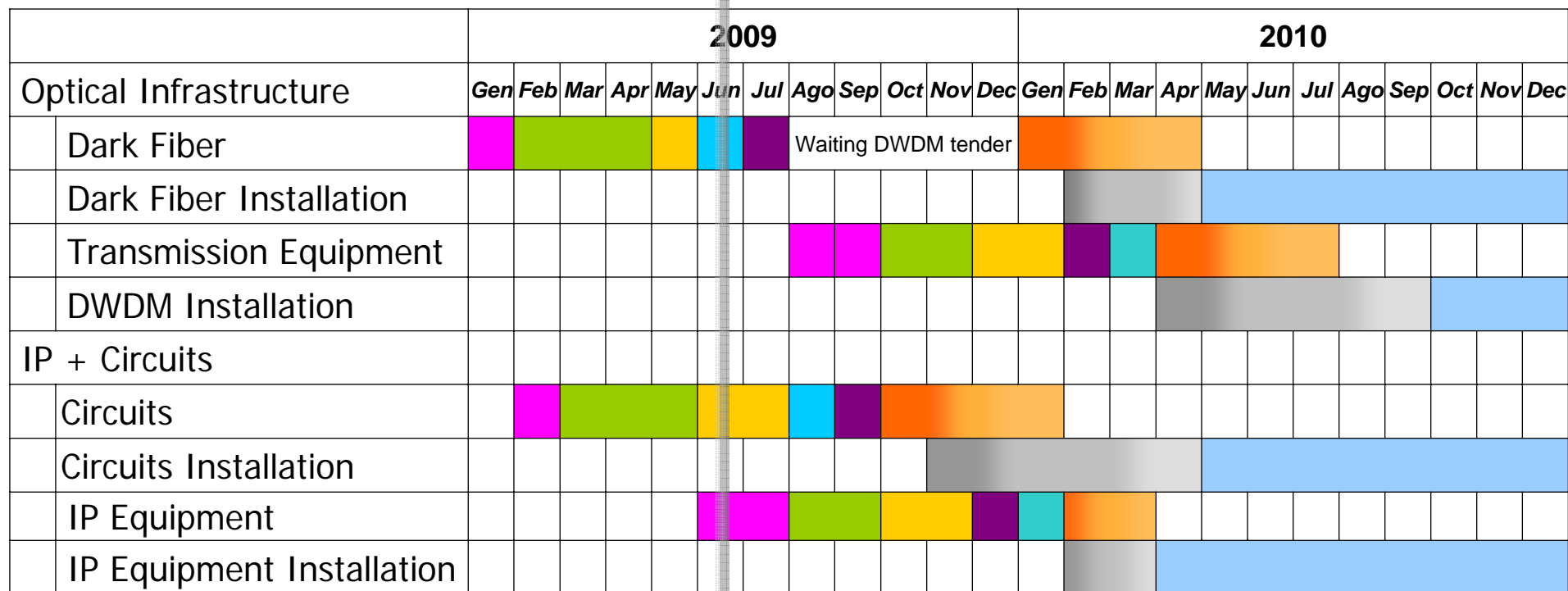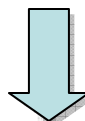9° W... GARR, Rome - June 16th, 2009
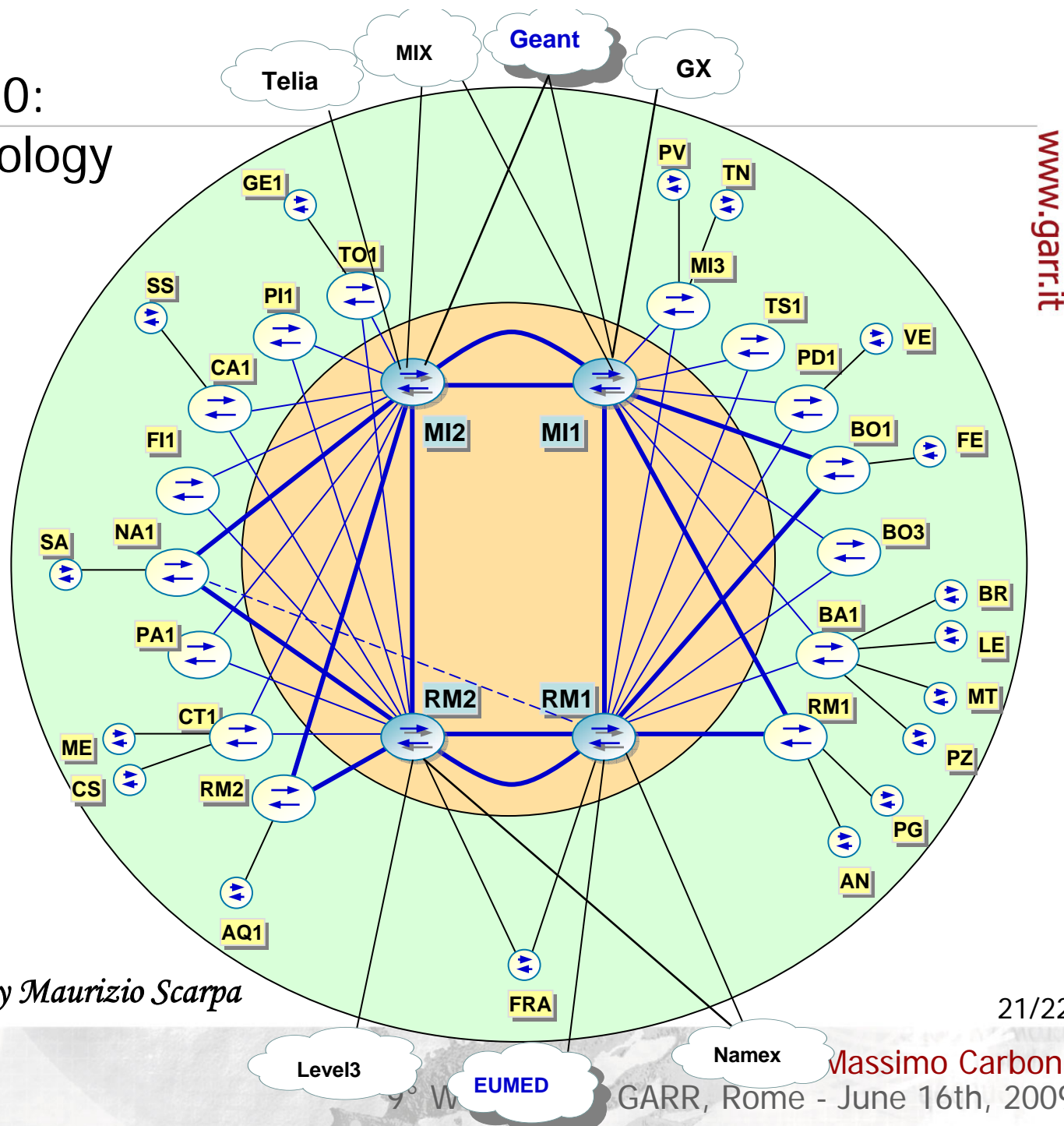
GARR-X Phase 0: Tenders Status

Legend:
- Emissione Bando di Gara (magenta)
- Risposta degli Operatori (green)
- Analisi Tecnica (yellow)
- Firma Contratti (cyan)
- Analisi Economica (purple)
- Ordine al Fornitore (orange)
- Installazione / Collaudo (gray)
- Gestione NOC (light blue)

Today

		2009												2010											
Optical Infrastructure	Gen	Feb	Mar	Apr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec	Gen	Feb	Mar	Apr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec
Dark Fiber							Waiting DWDM tender																	
Dark Fiber Installation																								
Transmission Equipment																								
DWDM Installation																								
IP + Circuits																								
Circuits																								
Circuits Installation																								
IP Equipment																								
IP Equipment Installation																								

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That's all folks

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