



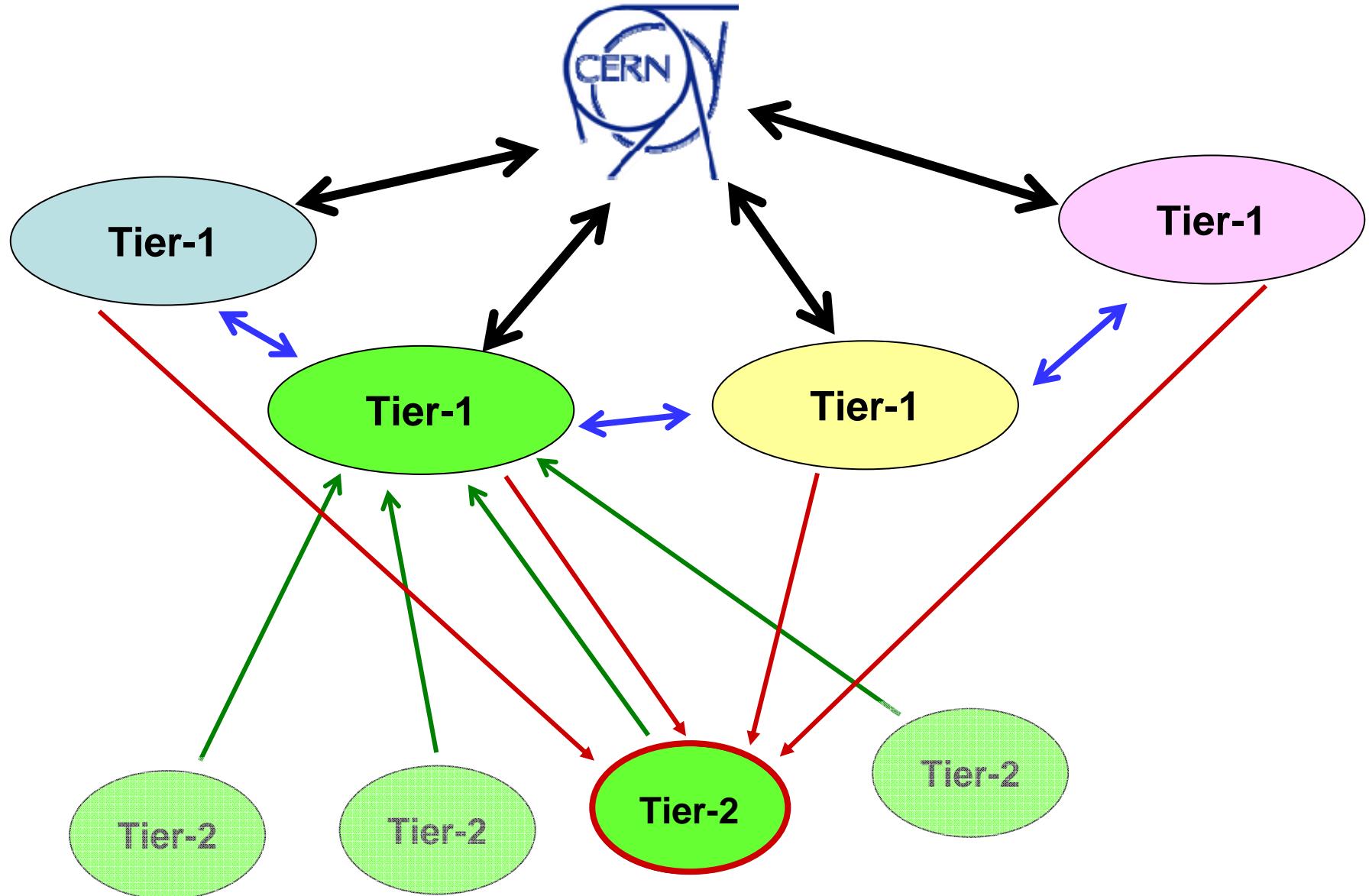
LHCOPN

The Optical Private Network for the Large Hadron Collider

Kors Bos
NIKHEF, Amsterdam

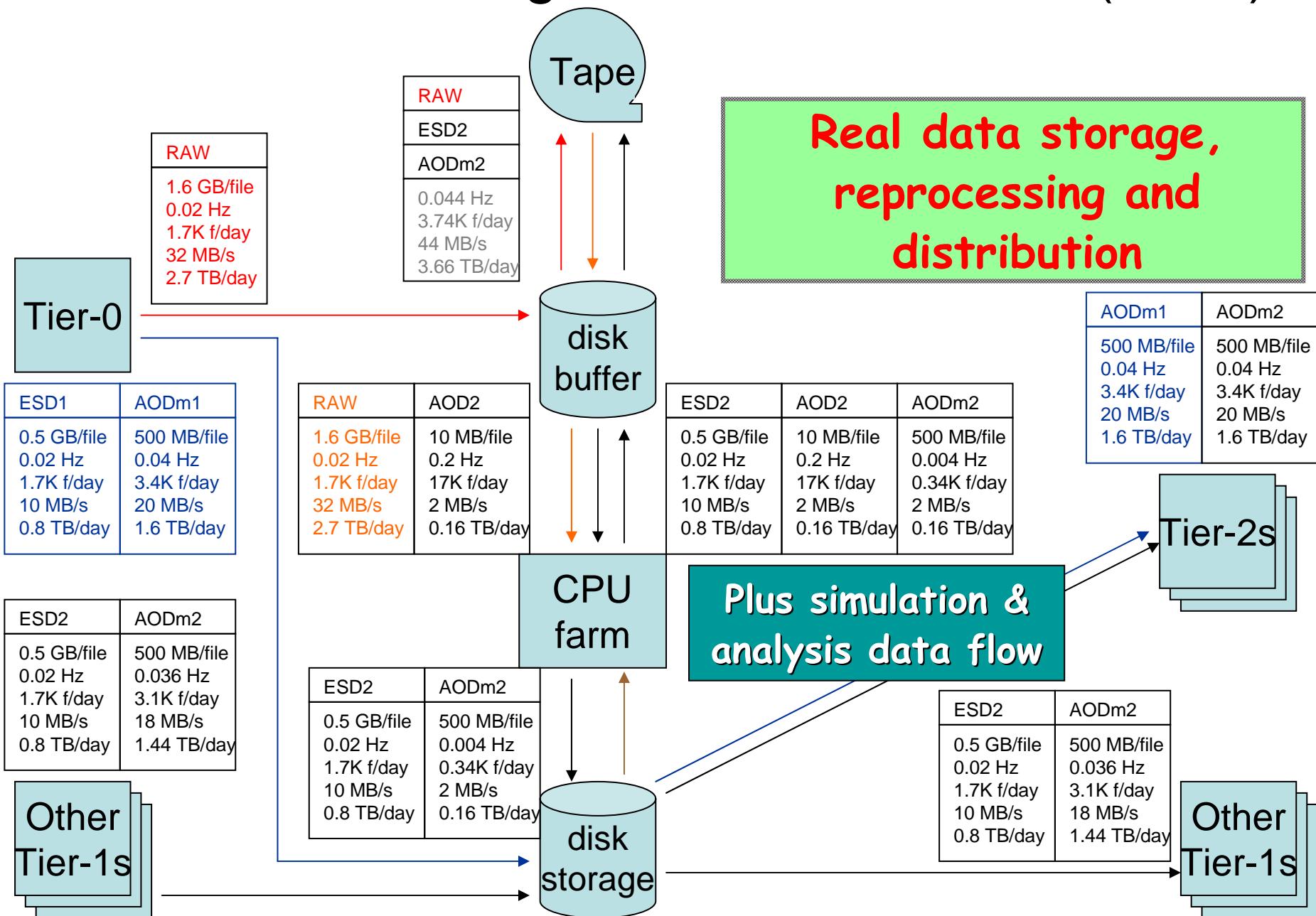
International ICFA Workshop on
**HEP Networking, Grid and
Digital Divide Issues for Global e-Science**

October 9-11, 2006 Cracow, Poland

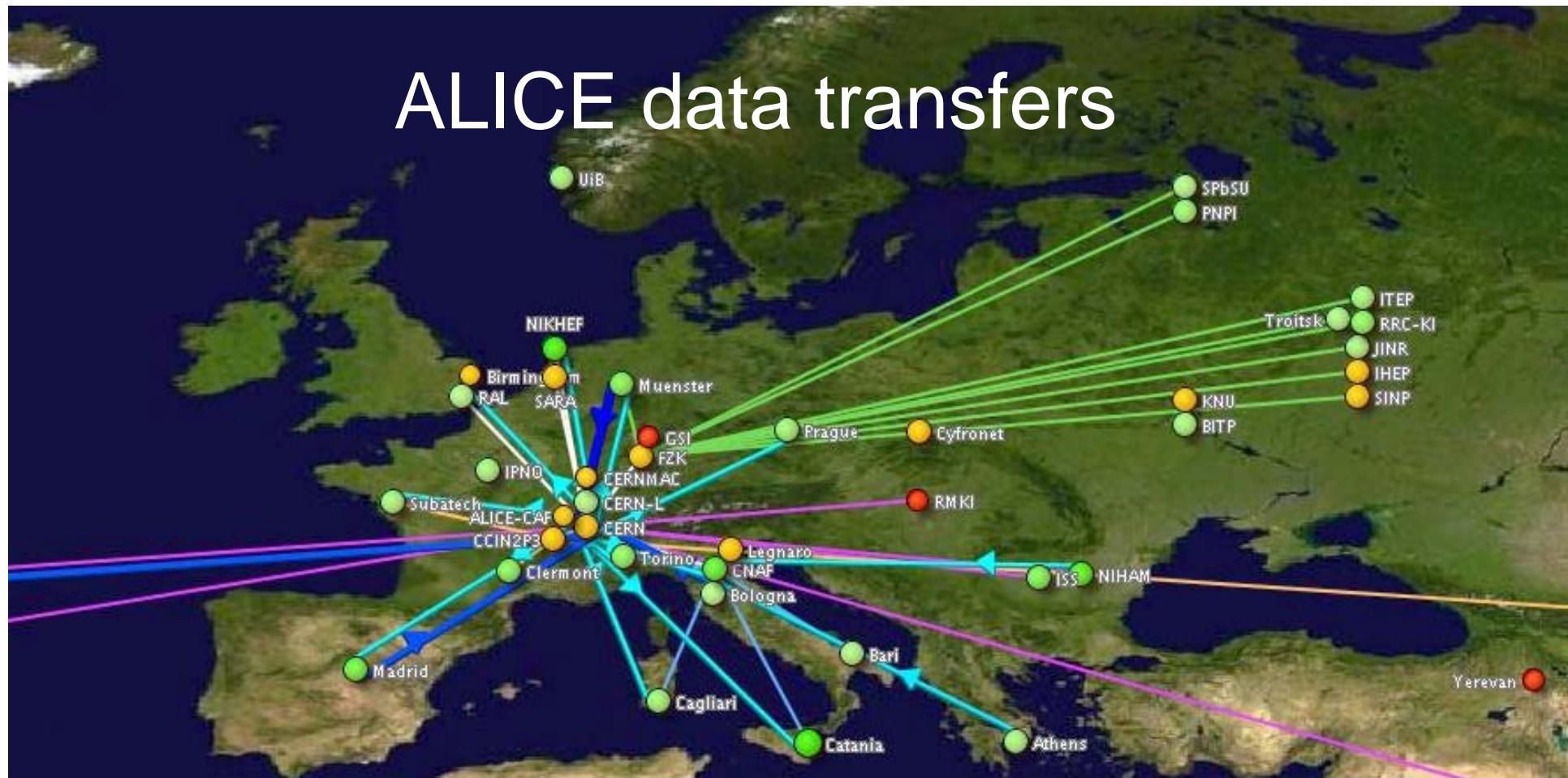


**Experiment computing models define specific
data flows between Tier-1s and Tier-2s**

ATLAS “average” Tier-1 Data Flow (2008)



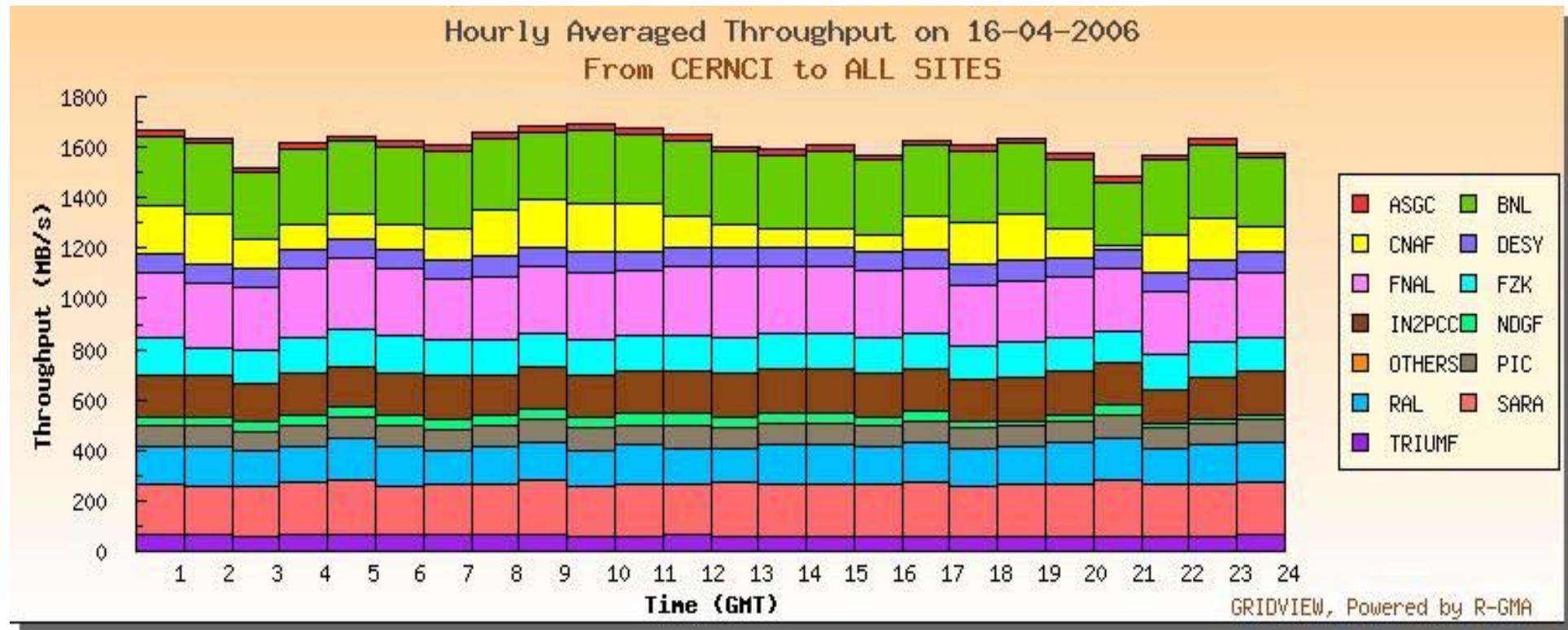
ALICE data transfers



<i>Tier-1</i> Centre	AU/CE	ATLAS	CMS	LHCb	<i>Rate into T1</i> MB/sec (pp run)
	Design target is twice these rates to enable catch-up after problems				
ASGC, Taiwan					100
CNAF, Bologna	X	X	X	X	200
PIC, Bologna		X	X	X	100
IN2P3, Lyon	X	X	X	X	200
GridKA, Karlsruhe	X	X	X	X	200
RAL, Didcot		X	X	X	150
BNL, NY, USA		X			200
FNAL, IL, USA			X		200
TRIUMF, Vancouver		X			50
NIKHEF, Amsterdam	X	X		X	150
Nordic Data Grid	X	X			50
Totals					1,600

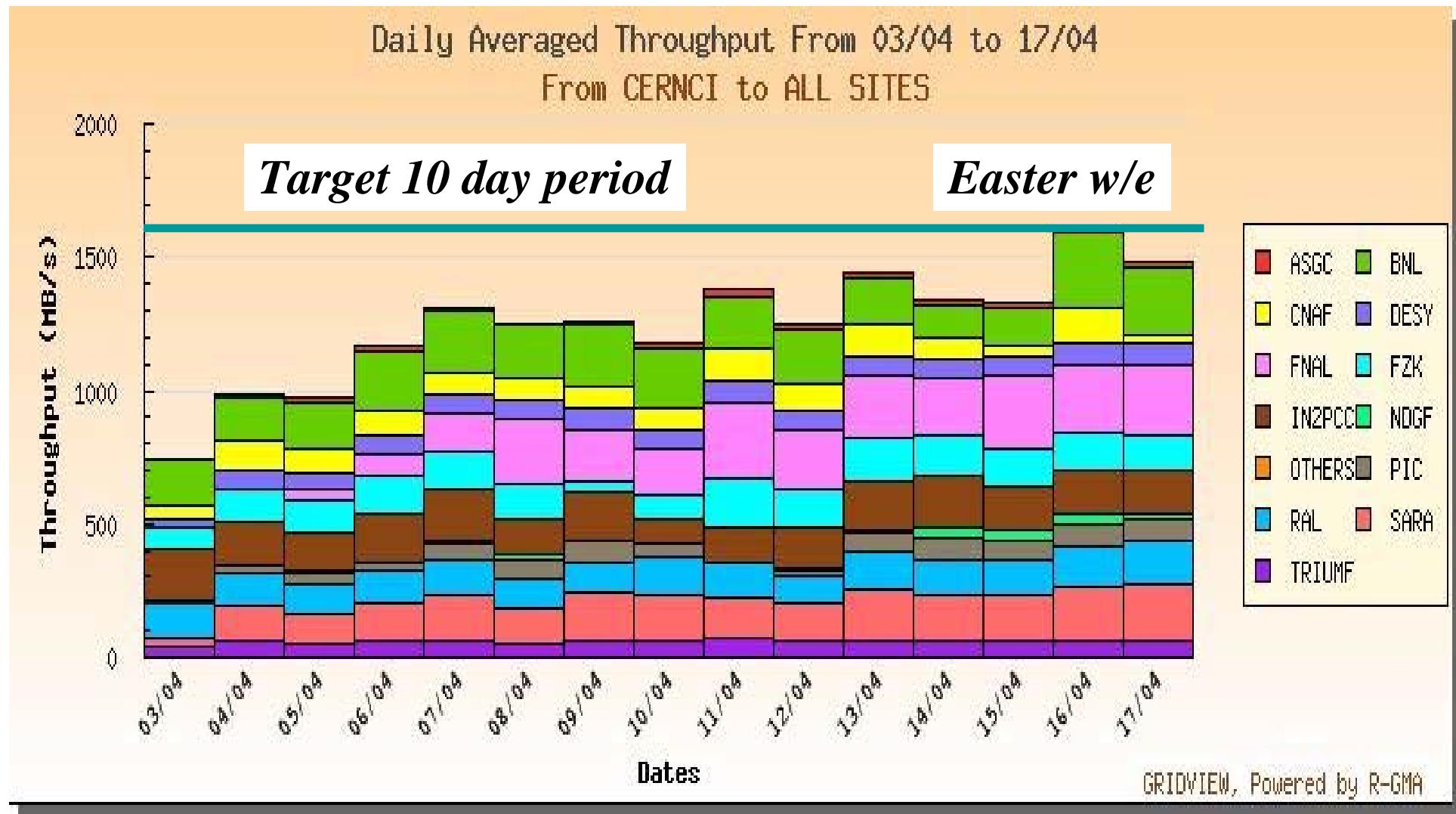
Data Distribution Tests

Tier-0→Tier-1s



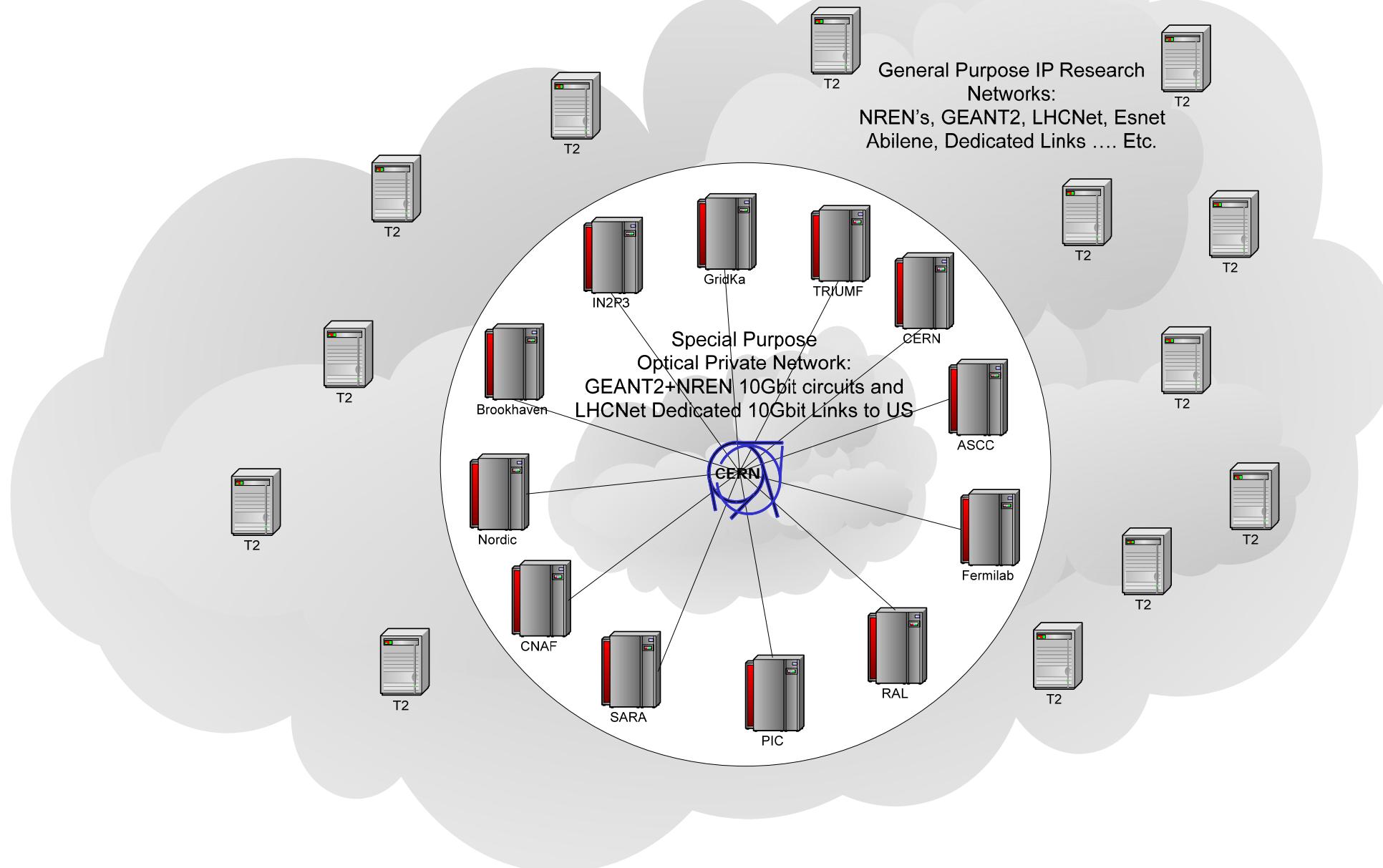
Disk to disk
July 2005 600 MB/sec
January 2006 1 GB/sec
April 16 2006 1.6 GB/sec

Goal reached on Easter Sunday

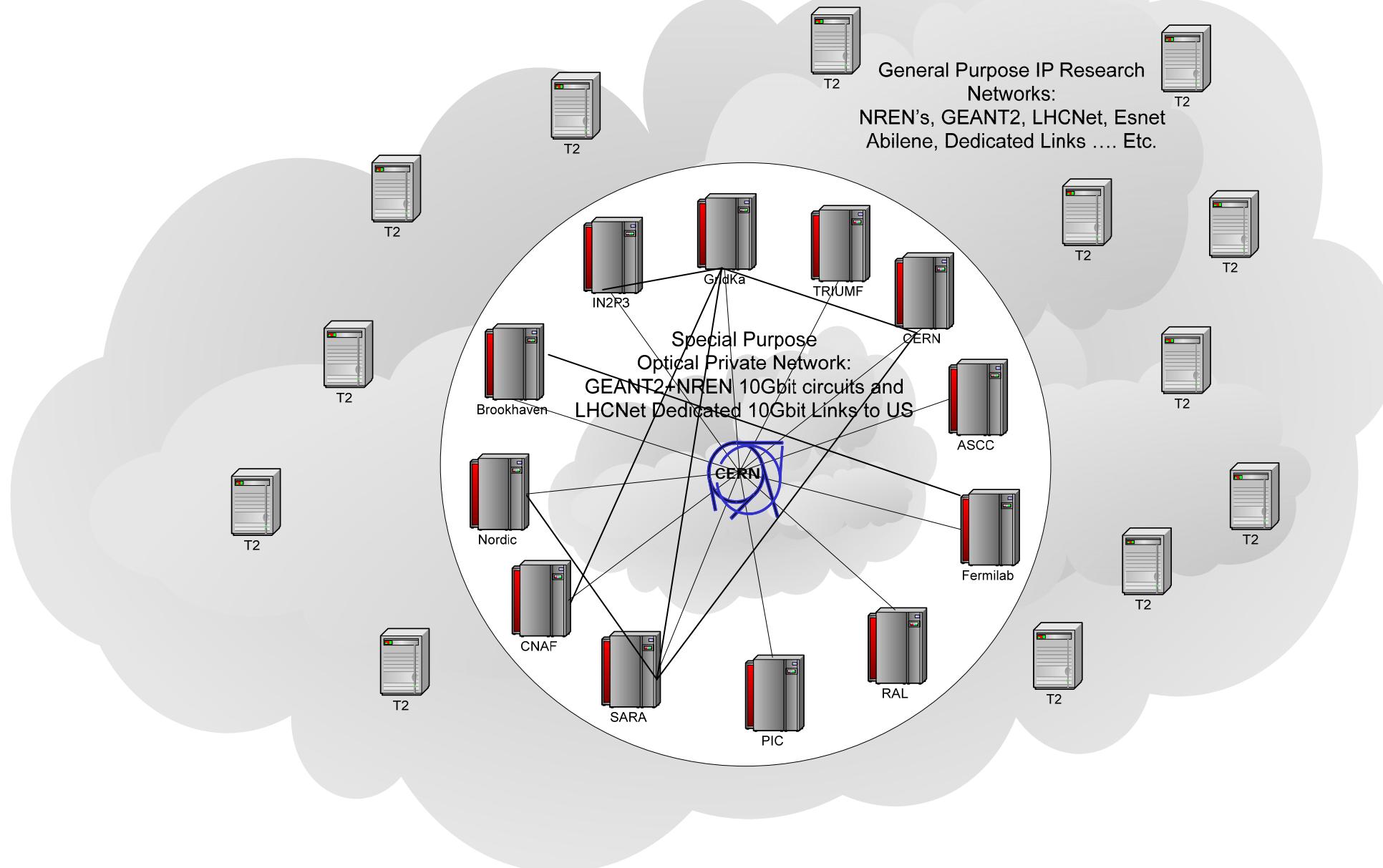


Centre	T0->T1	T1->T2	T2->T1	T1<->T1
	Predictable – Data Taking	<i>Bursty – User Needs</i>	Predictable – Simulation	Scheduled Reprocessing
IN2P3, Lyon	168.9	286.2	85.5	498.0
GridKA, Germany	179.3	384.9	84.1	395.6
CNAF, Italy	214.7	321.3	58.4	583.8
FNAL, USA	110	415.0	52.6	417.0
BNL, USA	186.5	137.7	24.8	358.0
RAL, UK	111.1	108.3	36.0	479.4
NIKHEF, NL	107.0	34.1	6.1	310.4
ASGC, Taipei	72.7	126.5	19.3	241.2
PIC, Spain	55.3	167.1	23.3	294.5
Nordic Data Grid	41.8	-	-	62.4
TRIUMF, Canada	19.2	-	-	59.0

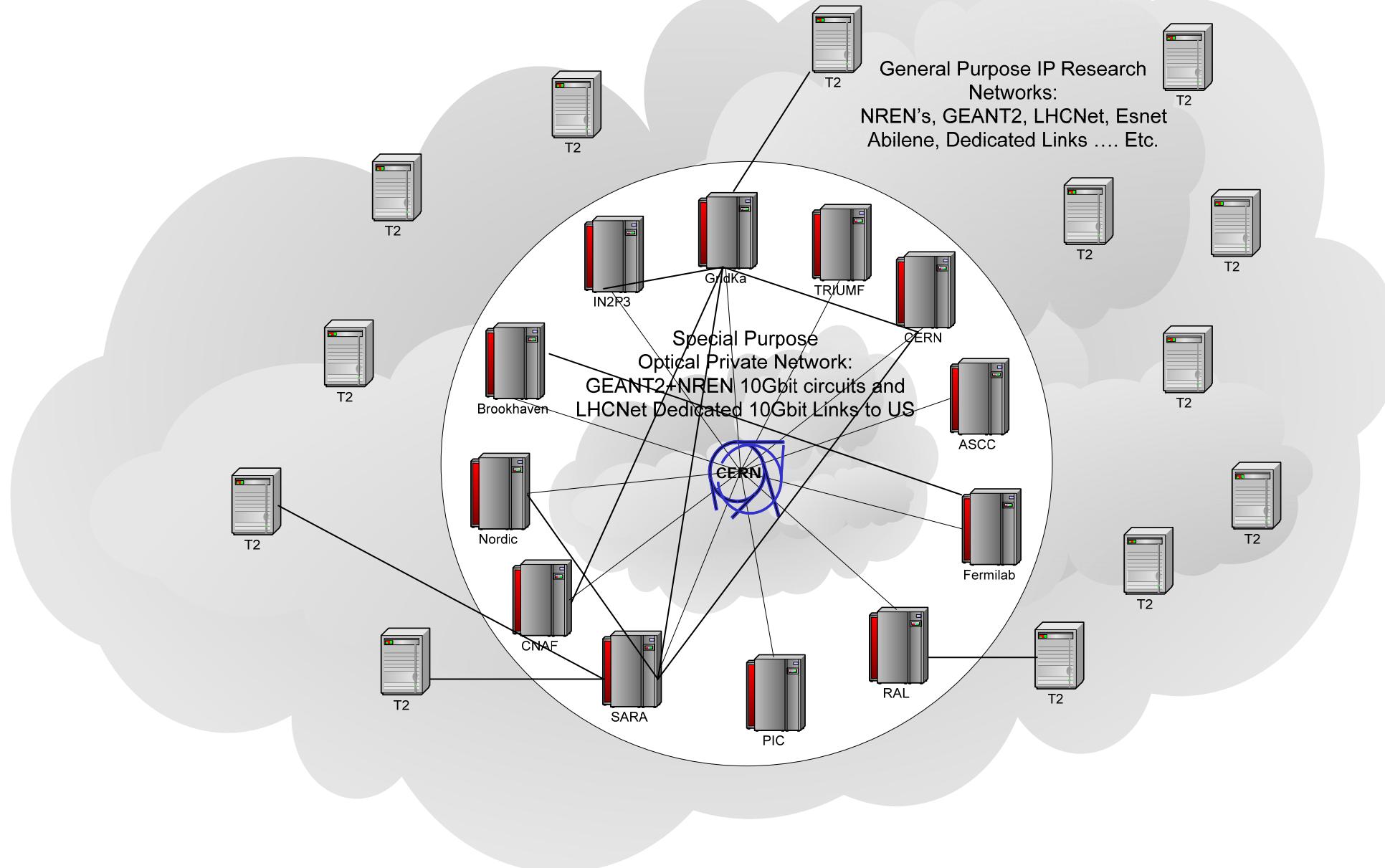
LHCOPN Architecture



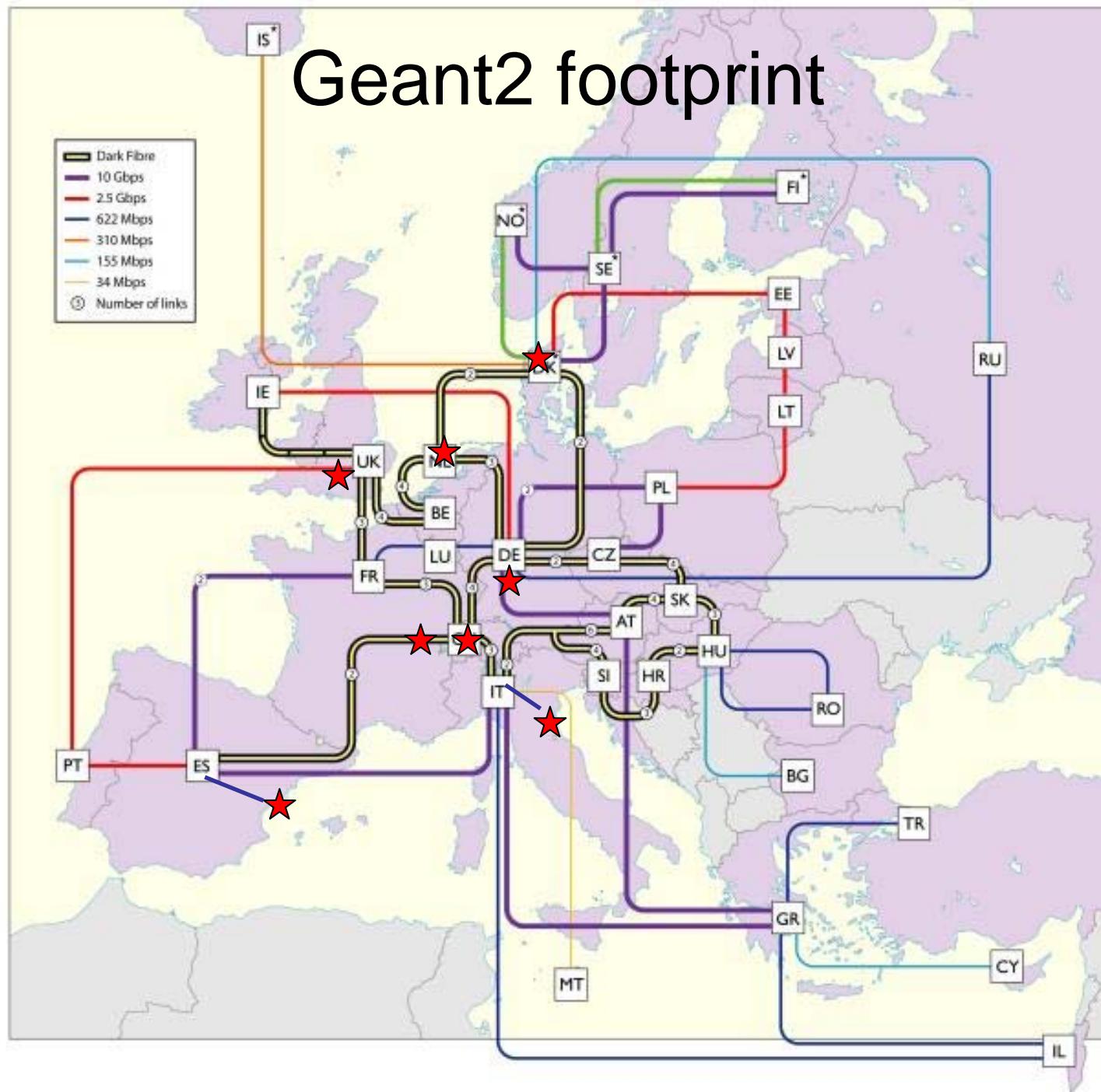
LHCOPN Architecture



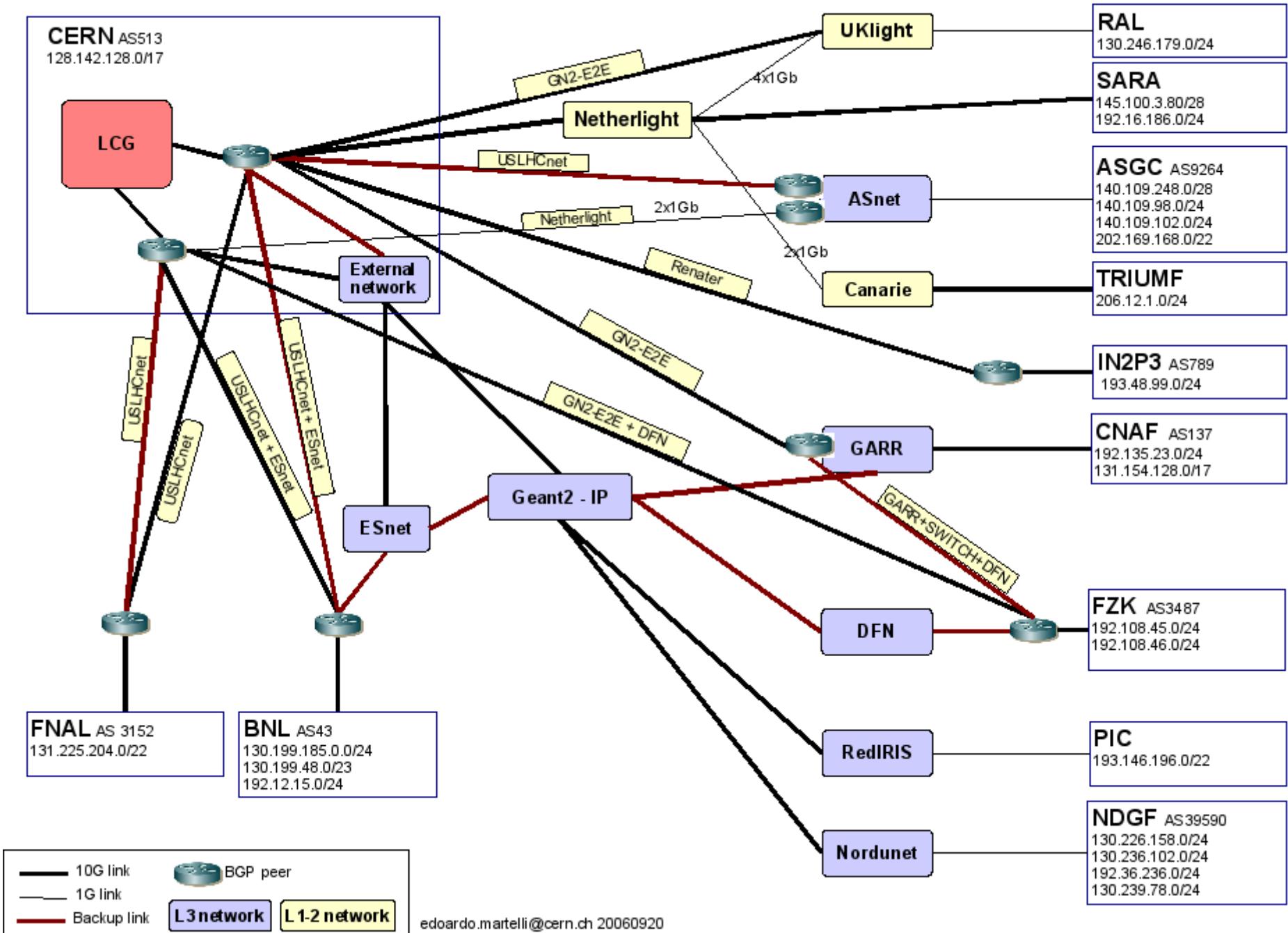
LHCOPN Architecture

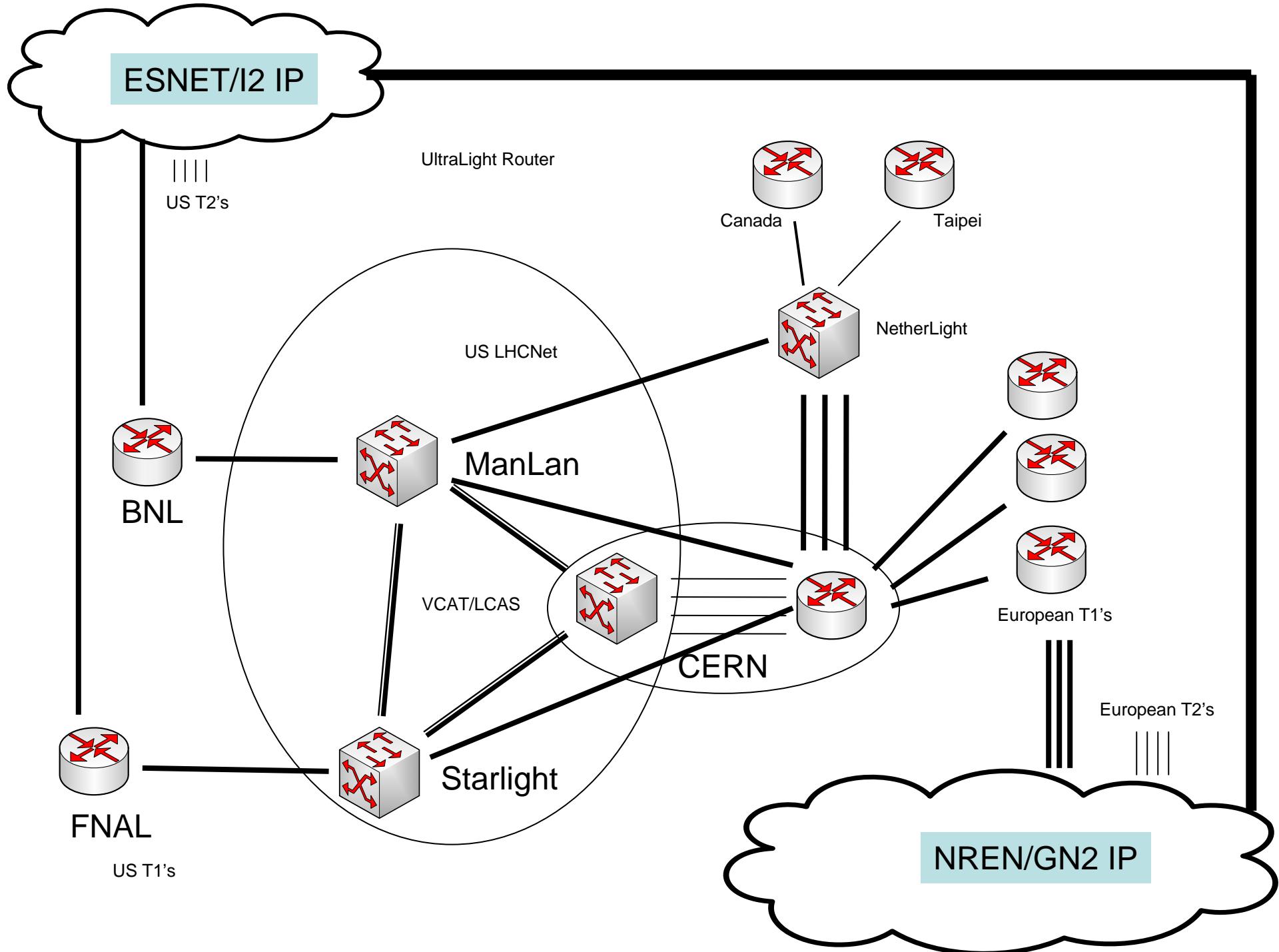


Geant2 footprint



LHCOPN – current status





OPN Status Summary

Link	Status	Nominal E2e Capacity	Provider Changes	Expected
BNL	OPN Production	10G	Colt->Colt	1/11/06
FNAL	OPN Production	10G	GC->Qwest	1/1/07?
TRIUMF	OPN Production	2G (10G to AMS)	GN2 Lambda CERN-AMS	Q4/06 (Need OME 6500 at CERN)
ASGC	OPN Production	2G (2.5G to AMS)	GN2 Lambda CERN-AMS	Q4/06 (Need OME 6500 at CERN)
NDGF	GN2 IP		GN2 lambda	Q1/07
SARA	OPN Production	10G	SurfNet->GN2	Q4/06
RAL	OPN TEST	10G		Oct 1 st 2006
FZK	OPN TEST/GN2 IP	10G		Oct 15 th 2006
CNAF	OPN Production	10G		
IN2P3	OPN Production	10G		
PIC	GN2 IP		GN2 lambda	Barcalona-CERN Mid Oct. PIC -> Rediris a problem

CBF Status Summary

Link	Status	Nominal E2e Capacity	Provider Changes	Expected
SARA - NDGF		10G		Q1 2007
SARA - FZK	In Test	10G		
FZK - CNAF	In Place	10G		
FZK - CERN		10G	DFN/Switch	Q2 2007
BNL - FNAL	In Place (from GC)	10G	To ESnet	Q2 2007
FZK – IN2P3		10G		Q4 2006

Other Links Summary

Link	Status	Nominal E2e Capacity	Provider Changes	Expected
ManLan - Netherlight	Ordered	10G	GC	1/1/07
Netherlight - CERN	Surfnet to make request to GN2 Exec	10G	GN2	1/1/07

Organisation

- **LHCOPN Meetings 4 times a year**
 - Organised as a sub-activity of the GDB
- **Current Working groups**
 - Operations (Dante)
 - Monitoring (USA)
 - Routing (CERN)
 - Security (UK)
- **Working group evolution**
 - Routing is now becoming the long term technical body
 - Monitoring has become the network instrumentation group
 - Operations will continue to be the problem determination and resolution
 - Security will continue to be an advisory and policy body.

Operational Status

- **Several links “in production” but coherent operational management across organisational domains must be organised.**
 - Agreement has been reached to deploy one initial monitoring tool “Perfsonar” across all domains.
 - Workshops have been held (Dante)
 - Munich 19 July 06: DANTE, DFN, REDIRIS, GARR, SURFnet, NORDUnet, RENATER, CERN (and LRZ-Munich)
 - Toronto 18-19 September 06: DANTE, I2, ESnet, TRIUMF, Canarie, FNAL, USLHCNET
- **End-to-End coordination unit (E2ECU) being implemented by Dante as part of the overall NOC – Full Operation January 2007.**
- **ENOC providing information integration with Grid Operations (EGEE-SA2) working closely with E2ECU**
- **All operational information documented on the LHCOPN Twiki: <http://lhcopn.cern.ch>**

Current Monitoring Activities

- VCs every two weeks to discuss progress, issues and timetable for e2e monitoring data being made available
- CNAF-CERN (T1-T0) monitored e2e
- CNAF-GRIDKa (T1-T1) partly done
- Most EU NRENs expect to be ready before end of 2006
- Non-EU networks TBC

Perfsonar Status

NREN	HW	Status info	perfSONAR Installation	Expected RFS
GEANT2	Alcatel	Available	Done	Ready
DFN	Huawei	3 weeks ?	Done	End October
RENATER	Alcatel	November	Done	Mid-Nov.
REDiris	Nortel 8010	Unknown	TDB	Jan. 07 ?
NORDunet	Not disclosed	Stated available	October	Dec. 06 ?
GARR	Juniper/ADVA	Available	Done	Ready
SURFnet	Nortel	Available	Ongoing	End October
UKERNA	Nortel+Ciena	Available ?	Ongoing	Dec. 06 ?
SWITCH	Sorento	Available	Done	Ready

Ongoing Activities

- LHCOPN Meeting will continue (frequency is every 3-4 months)
 - Need to provide advice on performance tests to T2's that prove to be inadequate.
- Evolution towards long term support is ongoing
 - Long term technical working group
 - E2ECU and ENOC functions

Risks/Uncertainties

- Network infrastructure for LHC relies on multiple funding sources
 - CERN (LCG), EU (GEANT), DOE(USLHCNET, ESNET), NSF (Internet2), Governments (NRENs)
- Data Models presented (MegaTable) fit with the physical infrastructures so far, but are they right?
- NOC infrastructures are not strictly 24x7 so we will rely on backup strategies for outages.

The End

