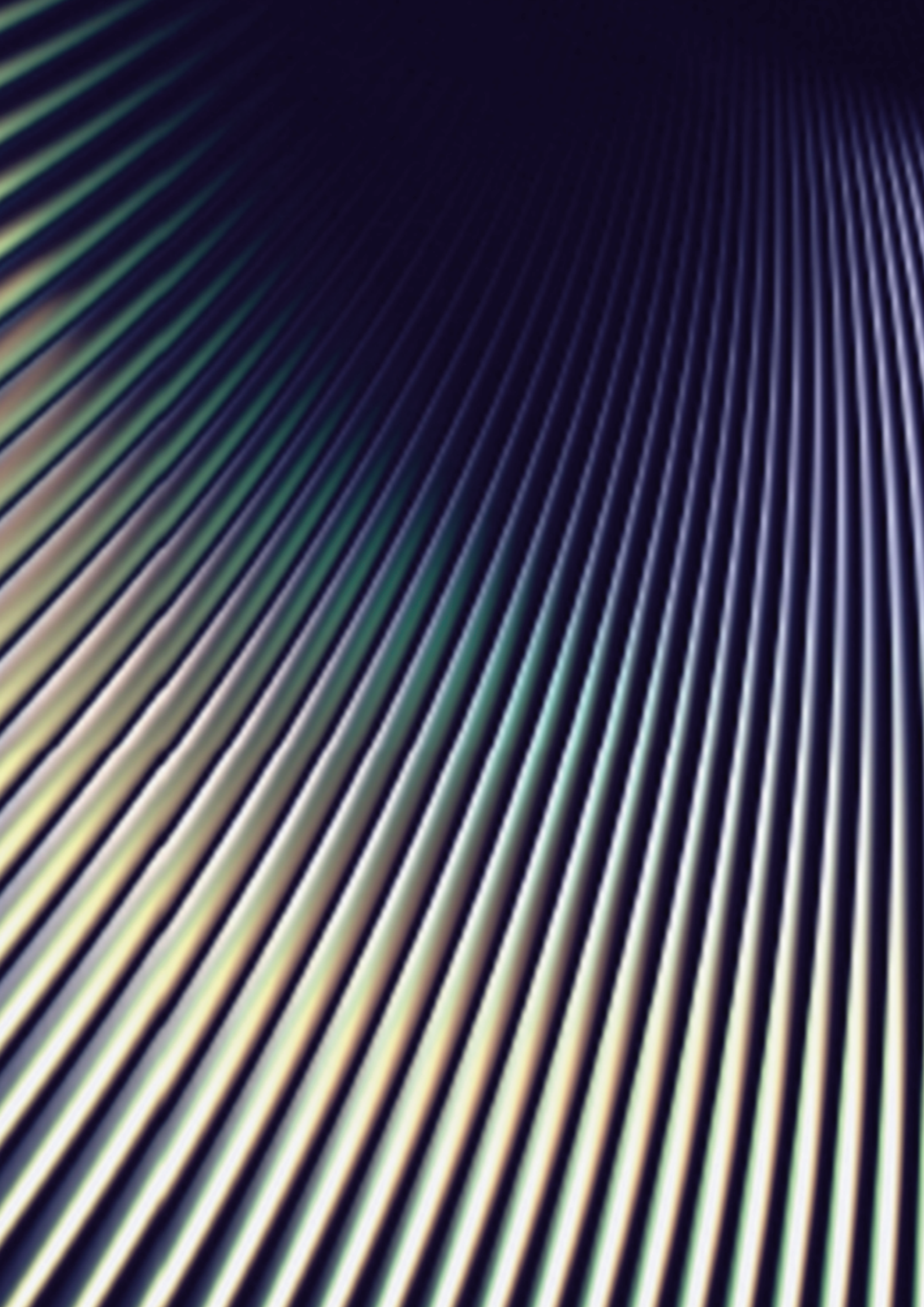
DANTE

ENABLING INNOVATIVE RESEARCH

DANTE ANNUAL REVIEW
2008



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Chairman's Report

Amidst the economic disruption of the last twelve months, it is easy to overlook the success story that is pan-European research networking. Global collaboration amongst scientists, academics and researchers is delivering innovation in both applied and blue sky research, helping to solve some of the largest problems that are affecting mankind. Climate change, disease control, weather prediction, crop research, medicine and astronomy all have two major things in common – they cannot be solved by scientists working in isolation and research in these areas generates huge amounts of data that needs to be collected, shared and analysed. This is where DANTE, and its partner European NRENs in the GÉANT consortium, are making a major contribution.

For research of this scale to succeed, it requires high speed, high capacity networks, backed up by tailored services, to link researchers from individual institutions with their peers in different countries. Providing data communication solutions and delivering real-time connections is also very much a collaboration – the National Research and Education Networks (NRENs) and their coordinator DANTE, responsible for GÉANT operations, work together to link the research institutions to create the optimum environment for fostering innovative research.

2008 and 2009 have been years of change for DANTE as it has worked on a new generation of advanced research networks across the globe. One major addition to global networking has been the new high bandwidth ORIENT link connecting the Chinese NREN to GÉANT. The TEIN3 network is now into its third generation and is extending the reach of connectivity and linking further research communities across south east Asia while in Europe the advanced GÉANT network continues to lead the world in terms of reach, speed and user-focused services. GÉANT has benefited from connectivity upgrades to the Baltic, south east European and Iberian NRENs and from the addition of a high speed link to URAN, the Ukrainian NREN. The foundations of exciting new projects in the Black Sea region, central and southern Africa and central Asia have also been laid, fostering co-operation and bridging the digital divide in these areas.

Changes to the DANTE Board have included Bob Day, UKERNA and Rene Buch, NORDUnet. This report provides an overview of all these activities and plans for 2010, which promises to be even busier.

Klaus Ullmann,
Chairman of the DANTE Board

“DANTE is a unique organisation entrusted to build and operate networks that have the capacity to transform the way researchers worldwide and across multiple disciplines collaborate. Not only is every new DANTE partnership resulting in higher capacity and extending research’s global reach, but it is also making a huge impact in reducing the digital divide that still exists across Europe and the world. Projects using and benefiting from these networks have real impact on solving societal issues that can affect us all, such as disaster recovery planning, malaria vaccines, predicting volcanic eruptions and understanding climate change. The tremendous improvements to research and education networking over the last few years are attributable to our close working relationships with partners and institutions across the world and we look forward with confidence that the next few years will continue to be as successful.”

DAI DAVIES, General Manager, DANTE

Driving International Network Collaboration

Since its formation in 1993, DANTE has worked with organisations in Europe and around the world to plan, build and operate high speed international research and education networks. Collaboration is at the heart of DANTE's mission – it works with NRENs and other research network providers (such as Internet2 in the US and ALICE in Latin America) to ensure that users have access to the fastest, most comprehensive range of networking services and tools to enable international, real-time collaboration. By building inclusive, user-focused networks, in geographic areas such as Europe, the Mediterranean, Latin America and Asia-Pacific, DANTE has helped create a global community of researchers and contributed to bridging the digital divide.

DANTE's main objective has always been to provide international research connectivity between national research networks in Europe. As research has become more complex, the size of data files has grown exponentially, while the commercial Internet has never been able to provide the scale and reliability of bandwidth or quality of service that researchers require. Indeed in a few cases, the only way of swapping such large files is by physically sending them through the post, adding major delays to the research process and cutting the ability to collaborate in real time.

Network Management

Initially formed by 15 NRENs, DANTE now works with over 30 NRENs and other project partners, such as TERENA in Europe, to co-ordinate, build and manage networking projects. The European Commission is promoting these activities through grants which are gratefully accepted by the research community. Since the successful launch of the original EuropaNET project in 1992, DANTE and different groups of collaborating NRENs have used their experience and knowledge to work on further projects across the globe. These not only allow academic collaboration but directly impact the lives of citizens by the benefits brought from activities in areas such as telemedicine, crop research, weather forecasting and education.

As the operator of some of the largest, most advanced networks across the globe DANTE has always been at the forefront of new information and communication technologies (ICT). The original GÉANT network implemented the Internet Protocol version 6 (IPv6), providing greater capacity for addresses and increased security and consequently a more flexible, faster network. This use of IPv6 acted as a testbed for equipment manufacturers and provided a proof of concept before it entered the commercial mainstream. Moving forward, GÉANT2 was built on a unique hybrid model that brought together switched and routed infrastructure for the first time, paving the way for next generation, high performance, low-cost communication networks. The third generation of GÉANT, which will be launched later in 2009, focuses much more on the users, delivering seamless, flexible services tailored to their needs.

The network projects that DANTE manage provide much more than high speed connectivity and user-focused services. They extend the boundaries of collaborative networking and deliver a standards-based, international platform that to a certain degree also pushes the networking market forward.

DANTE is based in Cambridge, UK with over 50 staff spanning areas of project management, network planning and creation, service development, network management, customer support and commercial administration. It works for the NRENs in Europe and collaborates across the world, fostering inclusion and creating a virtual team that shares knowledge and best practice to benefit all.

Collaborative Working Structure

The complex and innovative world of research networking requires a truly collaborative approach if projects are to succeed. In the same way that researchers are working together on key projects in areas as diverse as radio astronomy and music, so DANTE and its partners collaborate to benefit users. Together with the NRENs, DANTE facilitates an end-to-end, multi-domain service that appears seamless and unified to users. To achieve this, close collaboration is necessary at the technical, practical and strategic level, sharing information and best practice amongst the wider research networking community to deliver optimal service to users.

Funding to drive these projects is provided by a combination of the European Union (through the 7th Research & Development Framework and EuropeAid initiatives) as well as funding from the NRENs themselves, creating a partnership that involves all key stakeholders.

Knowledge-sharing is at the heart of this collaboration. The model successfully implemented across Europe with GÉANT has been used to create research networking organisations, first with CLARA in Latin America and now with work underway with TEIN in South East Asia. These refine the structures and working practices originally created within DANTE, tailored for their individual needs. The growth of these regional networking organisations ensure that control and policy remains close to users and spurs the development of a mature, professional network industry in all areas of the globe.

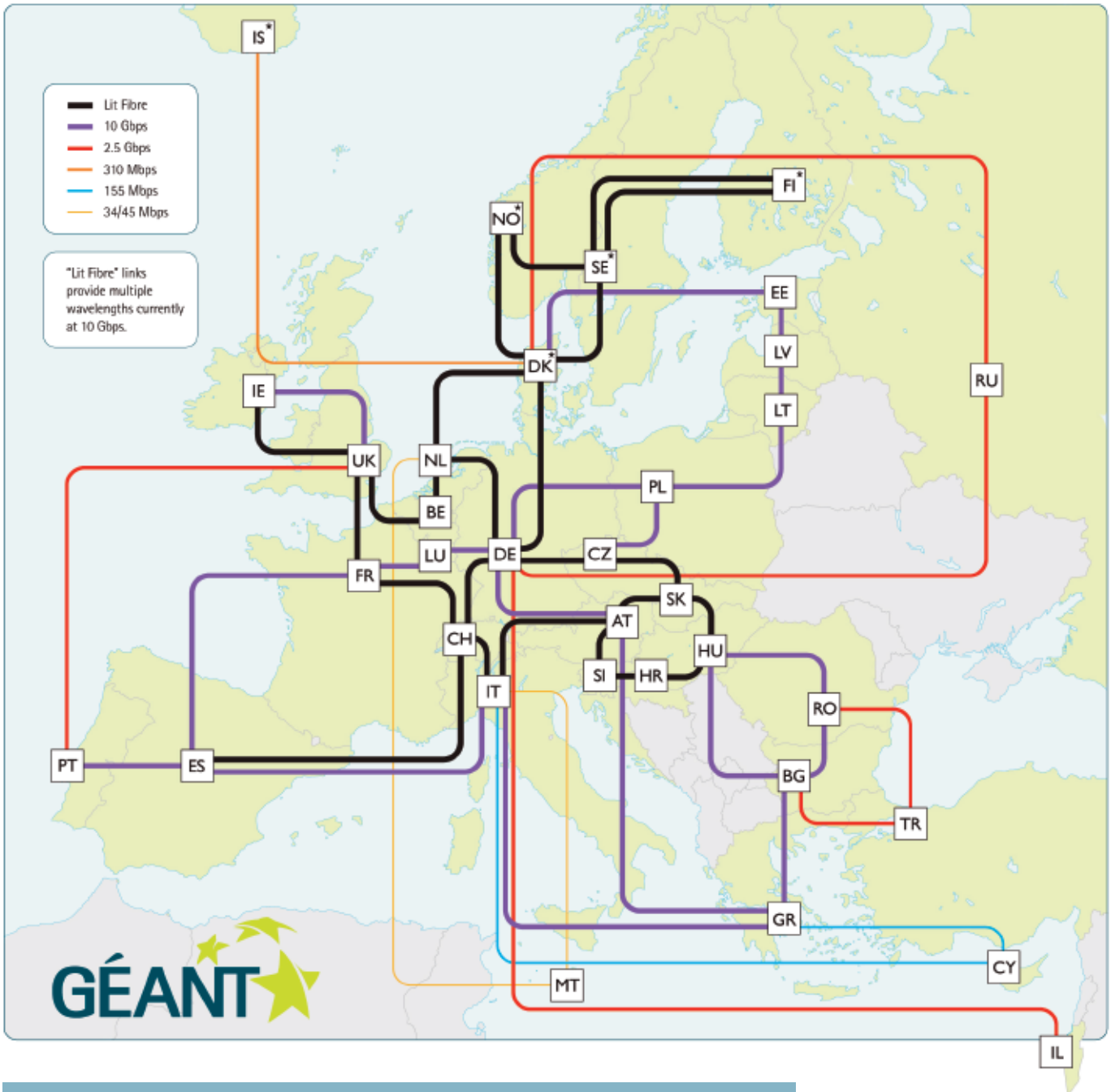
A successful research infrastructure is a catalyst for positive change. Research is central to both European competitiveness and the development of economies across the world, improving the lives of millions. In Europe, GÉANT provides the e-infrastructure at the heart of the EU's European Research Area, underpinning major research initiatives to meet the EU's aims. Across the world, research networking bridges the digital divide and aids the creation of knowledge-based economies in areas such as Latin America, Asia and Africa.

> **The unique partnership between Europe's NRENs and GÉANT creates a network of networks, connecting researchers across the continent. By working alongside our users, we can meet their needs and deliver services at a local level for use across the whole pan-European GÉANT service area and enabling international research collaboration. The NREN and GÉANT alliance is vital to ensure users receive the seamless connectivity and service they require to stay at the forefront of research.**
>
> *John Boland, Chief Executive, HEAnet, Ireland*

GÉANT

GÉANT is DANTE's flagship project. Through Europe's National Research and Education Networks (NRENs) GÉANT connects an estimated 40 million users in 40 countries across the continent, making it the largest and most advanced research network in the world. Working closely with the NRENs, GÉANT covers a network infrastructure of 50,000 km, including 12,000 km of dark fibre – greater than the distance from London to Auckland.

The GÉANT network is a world-first multi-domain hybrid networking infrastructure, using switched and routed technology. This enables it to cost-effectively deliver data at speeds of up to 10 Gbps, far in excess of commercial operators.



Backbone Topology April 2009. GÉANT is operated by DANTE on behalf of Europe's NRENs

GÉANT is about far more than high speed and comprehensive network reach. As more and more researchers, especially in non-technical fields, collaborate internationally they require reliable, end-to-end services that are simple to use, secure, fast to set up and flexible to meet their needs. Essentially the network has to be invisible but deliver a high standard; a high speed utility that underpins user requirements through connectivity and services.

DANTE has invested heavily in talking to its partners to create and support services that are designed to foster new forms of collaboration. Examples include:

- eduroam that allows individual researchers to have secure, remote access to resources in their 'home' institute when travelling overseas
- High speed point-to-point connections that provide guaranteed high bandwidth connections between research institutions for particular projects
- Video conferencing to enable discussions and demonstrations in high quality throughout Europe and beyond

2009 sees the introduction of the third generation of the GÉANT network, which creates a "network of networks" by interconnecting the national networks of the NRENs. As part of the project, GÉANT will develop and roll-out multi-domain and federated services to all countries, creating a platform for European research needs; the GÉANT Service Area.

This GÉANT Service Area will provide end-to-end connectivity and support services reaching across national boundaries, delivering seamless connectivity to researchers. By combining infrastructure with an advanced portfolio of services, users will benefit from secure access to the network and resources they require, when and where they want it, transforming how research can be carried out.

Like many projects, GÉANT is co-funded by the European Commission and the NRENs. It is a flagship EU project that plays a crucial role in three strands of the European Union vision for research. GÉANT:

- Provides the e-Infrastructure at the heart of the EU's European Research Area, allowing easier, more productive collaboration across the region
- Acts as a testbed for the development of emerging internet technologies that will feed into the success of the European technology industry
- Actively works to bridge the digital divide, both in Europe and across the globe through its links to other research networks

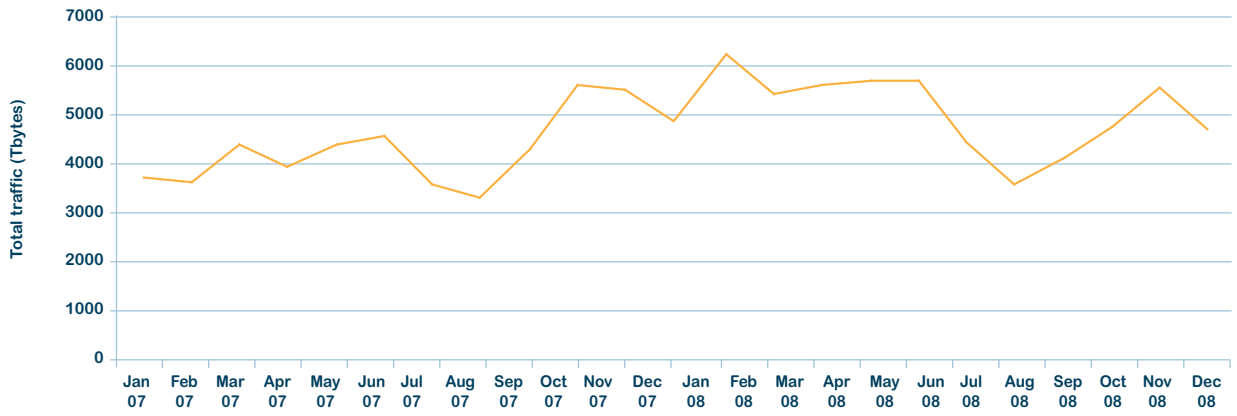
“EXPReS is a radio-astronomy project using e-VLBI (electronic Very Long Baseline Interferometry) to create real-time pictures of specific areas of the universe and detailed images of some of the most distant objects in space. We rely on high speed GÉANT links to connect remote telescopes to our central data processor. Each observation involves the transfer of the enormous volumes of data, well over a petabyte per session. The use of the GÉANT network has fundamentally changed VLBI. Instead of waiting weeks for disks to be posted, the network provides the data in real time. The use of high speed networks allows our researchers to conduct observations of transient events such as supernova explosions and gamma-ray bursts and allows for high precision tracking of space probes, which was previously not possible.”

Huib Jan van Langevelde, Coordinator of the EXPReS project and Director of the Joint Institute for VLBI in Europe

Supporting the Future of Research & Education Networking

The needs of the research networking community are evolving fast and DANTE invests heavily to ensure that GÉANT meets and exceeds their requirements. GÉANT will build on its solid foundations to develop faster, secure, innovative user-focused services to meet changing needs. There has been a 30% increase in network traffic between January 2007 and December 2008 (see graph 1) and this trend is expected to continue. As research applications and datasets become larger and more complex, network speeds and capacity need to increase. Initiatives are underway that aim to increase the capacity of the core network by a factor of ten in the next three years, to reach 100 Gbps and to ensure fast, efficient connectivity.

DANTE is tasked with ensuring that this capacity is not restricted for use only by science researchers who are more likely to have the technical skills to understand and establish their networking requirements; but also across the arts and humanities as well. A simple model for non-technical users is essential to enable access to the GÉANT network services for the arts, culture and humanities projects and researchers. Delivered in a way that provides ownership of dedicated networks to groups of researchers, whatever field they are in, GÉANT services will drive network take-up and increases the benefits of collaboration.



Graph 1: Traffic volume across GÉANT in 2007 and 2008

Network Operations Centre

Given the size and scope of GÉANT, uptime and security are of paramount importance. To give better control, DANTE has established its own Network Operations Centre (NOC), a dedicated resource for monitoring the GÉANT network and ensuring an effective 24-hour support service. Working closely with NRENs to ensure national issues can be solved, the NOC uses multi-domain monitoring tools to maintain the performance of the GÉANT network.

DANTE invests heavily to ensure the highest levels of security across its networks. This is leading to the creation of an internal DANTE Security Service, which collaborates with its NREN partners to combat threats and share knowledge and skills across the research networking community. As well as the monitoring and analysis carried out by the NOC, anomaly detection and penetration testing tools enable the pinpointing of potential issues that can then be swiftly dealt with.

“The new Network Operations Centre will ensure the highest levels of service across our large-scale, complex networks. By investing in the creation of our own NOC we will reduce our operational costs through direct control in this area and can work towards the delivery of seamless connectivity for GÉANT and EUMEDCONNECT2 users.”

Toby Rodwell, Network Operations Centre Manager, DANTE

Future Internet Initiative

GÉANT is a key part of the EC-funded Future Internet Initiative, which aims to drive innovation to provide the services of tomorrow. Building on techniques such as grid and cloud computing, the Future Internet Initiative is researching the creation of an Internet of Services, where new, interoperable services can be quickly developed and built on top of existing high speed infrastructure.

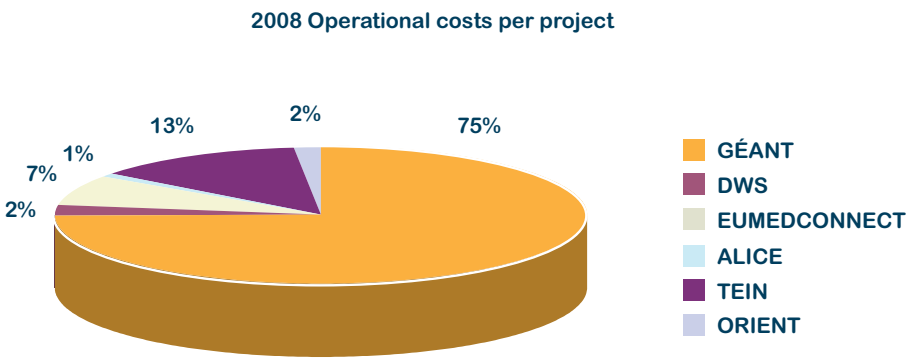
This work is concentrated in three key areas. The first is interoperability. Given that research infrastructures encompass multiple, differing network architectures at campus, national and international level, ensuring they can work together is vital. Research into creating Federated Network Architectures that are harmonised in a multi-domain world will ensure seamless, end-to-end provision of services, wherever users are located.

The second trend is using virtualisation technology to make it easier for users to create their own networks 'on demand' to support collaboration. New networks such as GÉANT, are being built to deliver this capability from the outset, enabling private networks, with dedicated bandwidth that can be deployed quickly and without affecting other users.

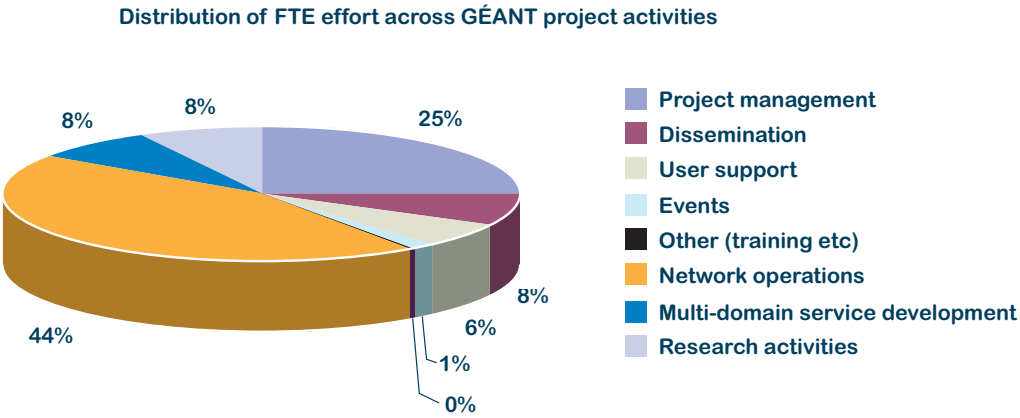
To achieve an Internet of Services, it must be easy and secure to develop, deploy and access new services. The idea of composable network services (being able to quickly create and install new services on the network from existing components) relies on the creation of a middleware framework that services can plug into. So a video conferencing service would include pre-built components for dedicated bandwidth and security/authentication along with the actual video conferencing application. As these will be automatically integrated through the framework they will be seamless and invisible to the user.

The power of these developments promise that the Future Internet, for both researchers and eventually the general public will provide the high capacity, service-based framework needed to underpin their requirements well into the future.

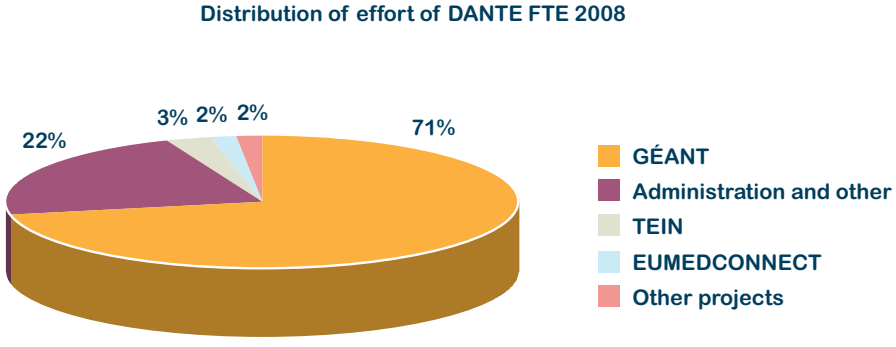
The GÉANT project is more than just a network project. Over 300 project participants, based across Europe in a variety of institutions collaborate, not only towards ensuring the current network infrastructure is operational and efficient, but are also involved in research towards innovative services to ensure seamless connectivity and looking at new ways to influence the Internet of the future. The graphs on page 11 show the time allocation for GÉANT project participants from 2008.



Graph 2: Breakdown of DANTE operational costs per project



Graph 3: Breakdown of time allocation within the GÉANT project

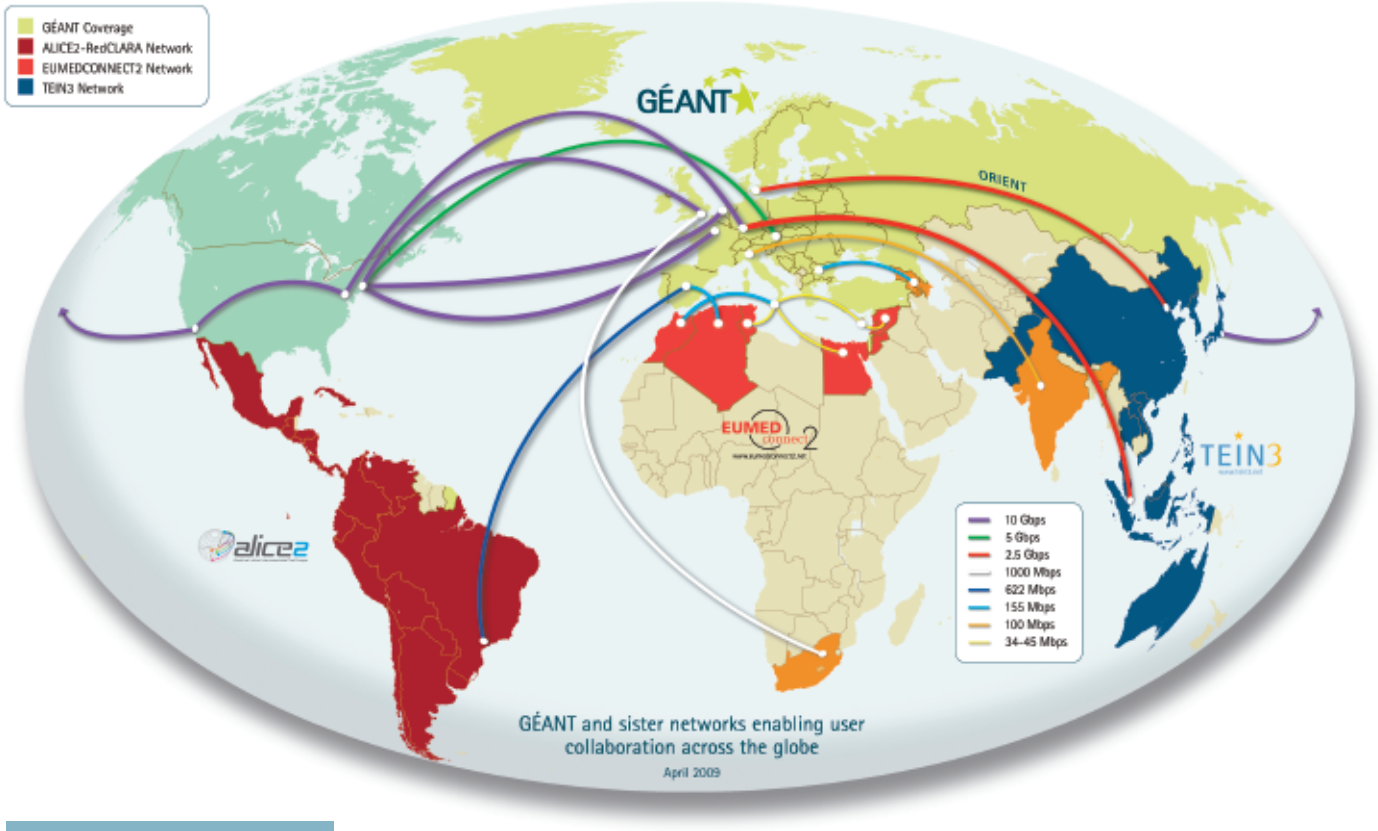


Graph 4: Distribution of DANTE time across regional projects

Global Reach

To meet the challenges of the 21st century requires a truly global research community, collaborating to solve issues in areas such as climate change, meteorology, crop research and medicine. Global research requires global connectivity, fostering partnerships between researchers across the world in order for them to work together to meet common goals.

Therefore the successful model behind GÉANT is now being applied in regions across the world, aiming to create this high speed, global research community. This brings together and develops local NRENs with the aim of building sustainable infrastructures that can take control of regional networks moving forward.



GÉANT global topology map

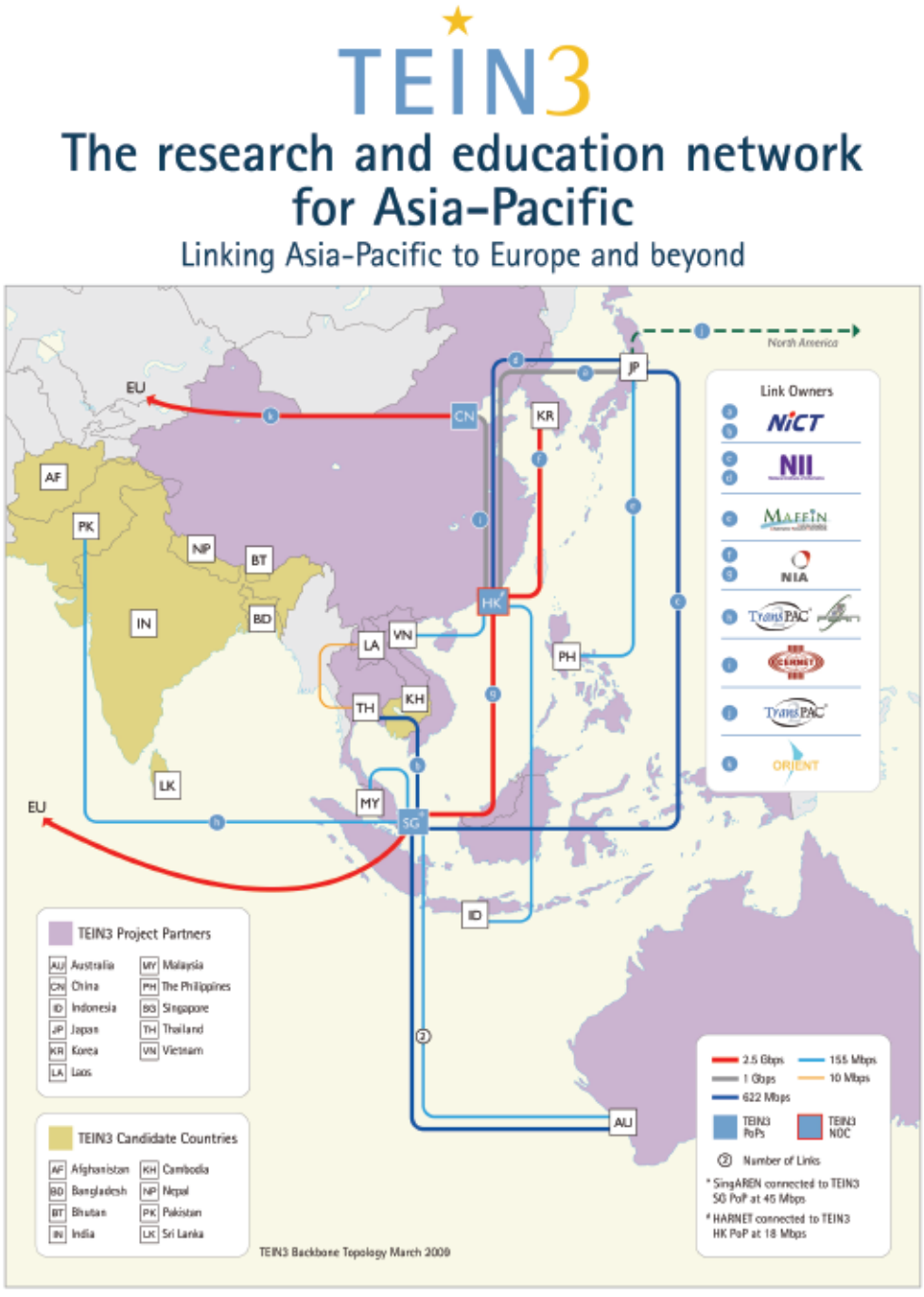
> **Joining TEIN2 made a huge difference to the research and education sector in Indonesia. For the first time collaboration was possible, not only nationally, but globally. Being part of the TEIN project and having access to the network bring so much more than bilateral links – it means joining a community. Today it is impossible to imagine not being a part of TEIN3 – it is Indonesia's connection to the rest of the academic world.**

Intan Ahmad, Institut Teknologi Bandung (ITB), Indonesia

TEIN3 (Asia-Pacific)

The Trans-Eurasia Information Network (TEIN) connects the research and education community across Asia-Pacific. TEIN3, the third generation of the project currently links 11 countries in the region to each other and the global research community with plans to expand its reach further into south east Asia. Announced at ASEM7 in October 2008, TEIN3 is scheduled to run until late 2011. TEIN3 is managed and operated by DANTE. Projects include climate research, satellite information and meteorology.

For further information, please visit **www.tein3.net**



TEIN3 topology map

ALICE2 (Latin America)

Originally created in 2003, the ALICE (America Latina Interconectada Con Europa) project provides a research network infrastructure across Latin America. Extended in 2009 through ALICE2, it covers 13 Latin American countries and connects to other regions through high speed links. A key part of the project has been the creation of CLARA, the Latin American research education network which is now responsible for the operation of ALICE and now ALICE2, with DANTE as a key partner. Innovative projects in areas such as telemedicine, volcanology and radio astronomy all rely on the ALICE2 network.

For further information, please visit **www.alice2.redclara.net**.

ALICE2 topology map September 2009

EUMEDCONNECT2 (Mediterranean)

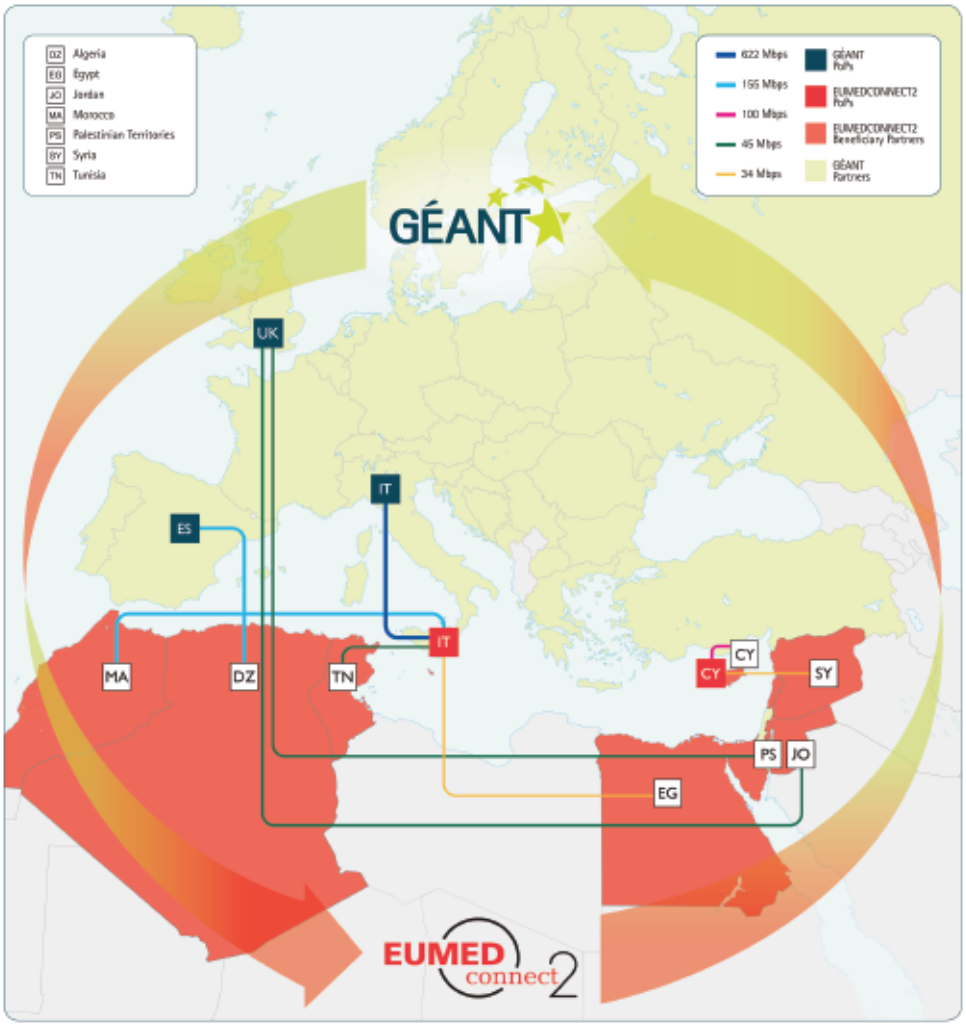
EUMEDCONNECT2 provides the Mediterranean with a gateway to the global research community. Spanning seven countries across North Africa and the Middle East, it covers 2 million users in 700 institutions, enabling them to collaborate with their peers within the region and in Europe. EUMEDCONNECT2 is managed and operated by DANTE. Researchers into e-science, archaeology and e-learning all benefit from its high capacity and wide reach.

For further information, please visit **www.eumedconnect2.net**.

EUMED connect 2

www.eumedconnect2.net

The Research and Education Network for the Mediterranean



EUMEDCONNECT2 backbone topology April 2009

ORIENT (China)

With over 15 million researchers and students, China is a vital part of the global research community. ORIENT connects GÉANT to the Chinese research networks CERNET and CSTNET, enabling collaboration across a joint research population of 45 million.

Since its launch in 2007, ORIENT has underpinned projects in radio astronomy, meteorology, sustainable development, cosmic ray observation, high energy physics and grid computing. ORIENT is managed by DANTE on behalf of European networks and CERNET on behalf of Chinese networks.

OREINT map

CAREN (Central Asia)

Upgrading the ancient Silk Road to the twenty-first century, the Central Asia Research and Education Network (CAREN) will create a high-performance Internet connection among the countries in the region and Europe. Scientists and students will use the latest technologies to communicate with their peers in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Scheduled to come into operation in 2010, CAREN will link over one million users in more than two hundred universities and research institutes and provide access to the European and global research community through interconnection to GÉANT.

CAREN builds on the achievements of the NATO-funded Silk project, with satellite connectivity now being replaced by terrestrial fibre-optic connections.

For further information, please visit **http://caren.dante.net**

CAREN map

As well as these ongoing projects, DANTE is involved in multiple initiatives to progress the development of research networks across the globe. These include the FEAST feasibility study into African networking and the Black Sea Initiative, which links the NRENs of the south Caucasus to GÉANT.

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Accounts

Income and expenditure account
for the year ended 31 December 2008

	2008	*2007*
	€ '000	*€ '000*
Turnover	49,830	54,829
Cost of sales	45,460	50,983
Gross Surplus	4,370	3,846
Administrative expenses	(4,548)	(4,081)
Foreign exchange profit	15	6
Operating Deficit	(163)	(229)
Interest receivable	363	387
Surplus on ordinary activities before taxation	200	158
Tax (payable)/recoverable on surplus on ordinary activities	(114)	21
Surplus on ordinary activities after taxation	86	179

Balance Sheet
at 31 December 2008

	2008	*2007*
	€ '000	*€ '000*
Fixed Assets		
Tangible assets	6,204	6,501
Current Assets		
Debtors	18,643	15,607
Cash at bank and in hand	18,431	16,528
	37,074	32,135
Creditors: amounts falling due within one year	35,548	31,174
Net current assets	1,526	961
Total assets less current liabilities	7,730	7,462
Provisions for liabilities and charges		
Deferred taxation	457	275
	7,273	7,187
Capital and Reserves		
Called up share capital	1,576	1,576
Capital contributions	35	35
Income and expenditure account	5,662	5,576
Total Shareholders' Funds	7,273	7,187

DANTE Shareholders

Organisation	Country	No of shares
ARIADNET	Greece	22,000
ARNES	Slovenia	22,000
CESNET	Czech Republic	22,000
DFN	Germany	165,000
FCCN	Portugal	22,000
GARR	Italy	165,000
HEAnet	Ireland	22,000
HEFC-E on behalf of JISC (UKERNA/JANET)	United Kingdom	165,000
HUNGARNET	Hungary	22,000
NORDUnet	Nordic Countries (Denmark, Finland, Iceland Norway, Sweden)	82,500
RedIRIS	Spain	55,000
RENATER	France	165,000
RESTENA	Luxembourg	22,000
SURFnet	Netherlands	110,000
SWITCH	Switzerland	110,000

DANTE Staff

General Managers
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Hans Döbbeling

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Julie Ball
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Milos Karapandzic
Otto Kreiter
Peter Nancollis
Krystyna Owen
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Susan Taylor
David West

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Helga Spitaler
Cathrin Stöver

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Rebecca Corn
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Luca Rinaldi
Toby Rodwell
Mian Usman
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Guy Roberts

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Tereza Murphy
Bhupendra Naik
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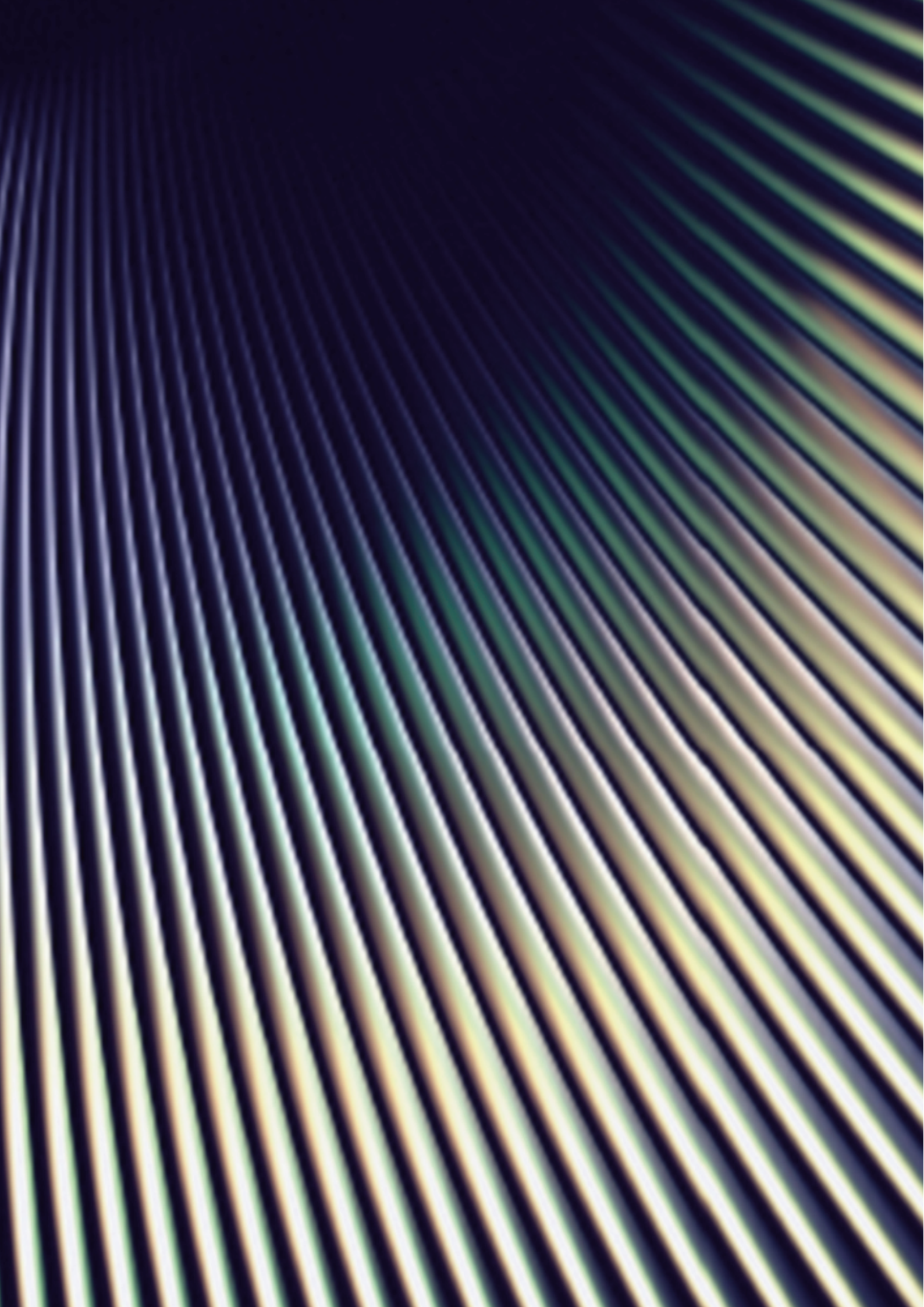
Fife Hope
Janet Lipski
Jean Reynolds
Roberto Sabatino

Klaus Ullmann, Chairman of the DANTE Board

Hans Döbbeling, General Manager, DANTE

DAI DAVIES, General Manager, DANTE

Matthew Scott, Chief Financial Officer, DANTE



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