



International Research Networking



# Expanding the reach of Grid applications in Asia through new network deployments

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# APAN Networks

- Networks in the Asia Pacific region continue to be developed & enhanced: within countries; between countries; & between geographic regions.
- In addition to initiatives catalysed by Asian countries, intercontinental programs such as TransPac2, GLORIAD, Translight Pacific Wave, ORIENT and TEIN2 have significantly enhanced network connectivity to the US and particularly to Europe
- A number of new cable systems are in planning or early deployment, we anticipate that network connectivity will continue to improve substantially
- The next schematic illustrates the current situation with respect to the Asia Pacific Advanced Network (APAN) backbone

# Asia-Pacific Backbone Topology



- APAN/TransPAC2(Affiliated)
- GEANT2/TEIN2(Affiliated)
- JGN2 SINET WIDE/IEEAF
- AARNet GLORIAD(Affiliated)
- Others

# TEIN2 is part of the regional (APAN) network fabric



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- TEIN2 is an acronym for the Trans Eurasian Information Network, Phase 2
- Launched at Halong Bay in June 2006
- Provides short paths to Europe (going west)
- Provides short paths WITHIN the APAN region (*cf* transit via US or Japan)
- Capacity ranges from 45Mbps to 2.5Gbps
- Complements the multi-Gigabit networks from Japan and Korea to the US
- Catalysed new NRENS (National Research and Education Networks) in Malaysia, Indonesia and Vietnam



## What is TEIN2?

- Intra-Asia regional network
- with Asia-Europe inter-regional links (both trans-Siberian and Indian Ocean)
- Funded by 10million Euros from European Commission + contributions from Asian partner countries
- TEIN2 programme aims to:
  - build and operate a regional network
  - promote network usage through catalysing applications
  - train technical staff in developing countries
  - reduce the digital divide

# TEIN2 Partner Countries- representatives



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## Asia Pacific:

Australia (AARNet)  
China (CERNET)  
Indonesia (ITB)  
Japan (MAFFIN, NICT, NII)  
Korea (NIA)  
Lao (LERNET)  
Malaysia (MDC)  
Philippines (ASTI)  
Singapore (SingAREN)  
Thailand (ThaiREN)  
Vietnam (VinaREN)

## Europe:

France (RENATER)  
Netherlands (SURFnet)  
UK (UKERNA)  
DANTE

## Also supported by:

TRANSPAC2  
Juniper Networks



# National Research & Education Network Organisations (NRENS)



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- The NRENS around the world have been fundamental in:
  - development of the Internet in their countries/regions, (eg technology transfer to industry: enhancing societal benefit)
  - the exploitation of advanced communications services:
    - researchers collaborate and share data virtually
    - educators/students share knowledge & discover/learn remotely
  - fuelling the information economy in their countries
  - building global infrastructure that will transform business, society and its institutions, and personal lives – like industrial revolutions of the past



# Expanding the Global REN footprint

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- Recent initiatives led to new NRENs, Regional RENs and global initiatives:
  - The Global Development Learning Network (World Bank)
  - The School of the Internet (WIDE Project)
  - The Virtual Silk Road (Central Asia and the Caucasus - NATO)
  - The University of the South Pacific (JICA, AUSAid)
  - ALICE/CLARA (South America – EC)
  - EDUMedConnect (North Africa, Middle East – EC)
  - TEIN2 (South East and North Asia – EC)





# The global NREN mesh underpins:

- collaborative innovation and information access on an unprecedented scale
- application of advanced services, tools and processes to aid design and management of highly complex systems
- more user-friendly applications using highly visual, interactive interfaces
- improvement and saving of lives through deployment of:
  - telemedicine
  - natural hazard warning & environmental monitoring
  - climate forecasting and extreme weather prediction
- “mining”, analysis, visualisation and interpretation of massive amounts of data collected from space, the earth and the oceans

# The Challenges for network-enabled Collaboration



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- Awareness raising – what can infrastructure and advanced communications services do to enhance research
- Which research areas can most immediately benefit (exemplars)
- Identifying discipline-based champions (characteristics & skill-sets)
- Engaging facilitators (understanding of research requirements and opportunities for exploitation)
- Convincing funding agencies of the wisdom of investing in both infrastructure, applications and collaboration environments
- Getting the balance right between research, teaching and societal benefit
- Time zone differences for international real-time collaboration



# Opportunities as part of the global NREN community



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- Research, Science and Technology
  - Researchers able to participate in global collaborative teams
  - Resources/knowledge available to the global research community
- Societal benefit
  - Improving lives as a result of implementing advanced communications that support the well-being of the population
- Catalysing and stimulating the information economy
  - Providing services to transform business, society, and personal lives.
  - Implementing collaborative innovation and access to information
  - Acting as incubator for technology transfer to industry and commerce

# EuropeAid funding for TEIN2

## Research vs Societal Benefit



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- Good networking can vastly improve societal benefit
- Improvement to peoples lives often a key element for funding support
- When combined with a research agenda eg
  - earthquake modeling/prediction
  - climate change research
  - remote immersive diagnostic systems for patient assessment
  - bioinformatics research to improve response and mitigation of emerging infectionsa compelling case may result
- Drivers depend on the needs of the country concerned and the ability to support the initiatives



# Societal Benefit - Paediatrics

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- TEIN2 has significantly enhanced the collaboration between the National Hospital for Paediatrics (NHP) in Hanoi and the Royal Childrens Hospital (RCH) in Melbourne, Australia
- This was demonstrated at the Halong Bay launch of TEIN2
- NHP and RCH now have regular videoconferences over TEIN2 to enhance joint activities



# Societal Benefit - Orthodontics



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- Dr Mike Snow, an orthodontist from Melbourne, comes to Vietnam three times each year to treat Vietnamese children with cleft lip and cleft palate deformities.
- He has developed a broadband-enabled dental assessment chair that will allow him to examine Vietnamese children while he is still in Melbourne
- Two broadband-enabled orthodontal examination chairs are now in Vietnam



Helping Children with Cleft Lip and Palate in Vietnam

GIÚP ĐỠ TRẺ EM KHẼ HỖ MÔI & HÀM ÉCH Ở VIỆT NAM





# Bridging the Digital Grid Divide

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- Do-Son school on Advanced Computing & GRID Technologies for Research organised by VAST, Vietnam; ISGC AS Taiwan; & CNRS France
- The school trains students and young researchers from all over Asia in the state of the art for grid technology
- The students were taught how to become users of grid infrastructures and how to use tools for simulation and data analysis
- Outcomes: researchers and students trained and 5 laboratories equipped to become grid nodes in Vietnam. Three laboratories were left with machines already configured as grid services using TEIN2.

# eVLBI using Trans-Siberian Path



## Status of the e-EVN



Network status as per 2007-08-21. Image created by Paul Boven -boven@jive.nl>. Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).



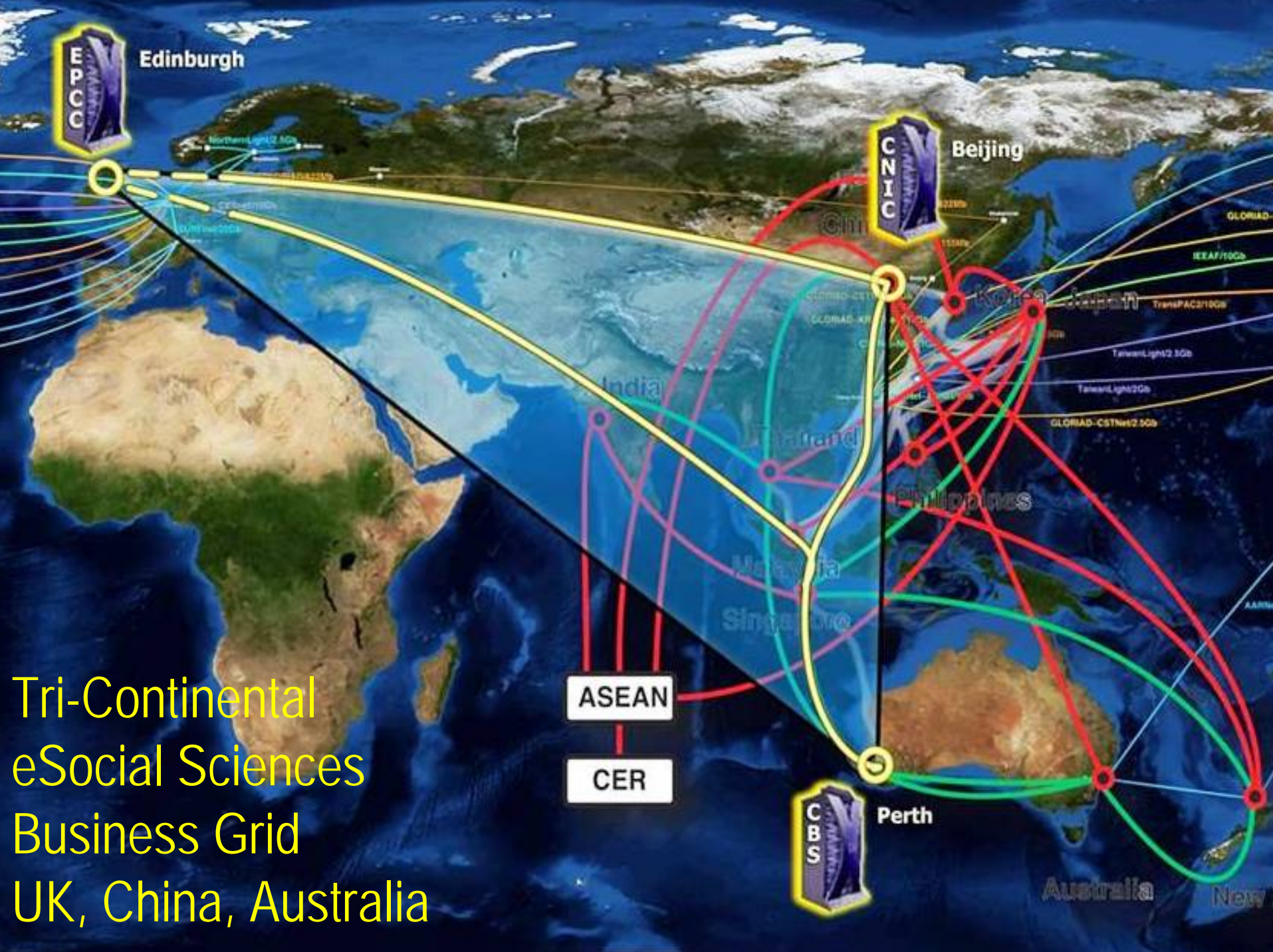


# Intercontinental Grid reduces latency via TEIN2



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- see Grid Today article - <http://www.gridtoday.com/grid/2180703.html>
- An e-social science “collaboratory” focused on understanding regional socio-economic behaviour in the context of global markets, involving the UK, China and Australia (see next slide)
- Prior to TEIN2 – all exchanges between these countries went via long trans-US routes with significant latency and complex routing issues
- TEIN2 lets data transit the shortest possible network paths improving performance of distributed computing jobs and providing a route that is faster, easier to manage and potentially more secure.
- While collaboration determines the endpoints of the network, the best-performing route depends on the match between the application and the network’s characteristics



Edinburgh

Beijing



Perth

ASEAN

CER

Tri-Continental  
eSocial Sciences  
Business Grid  
UK, China, Australia

# Application and Collaboration Frameworks



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*The transfer of the Cassini-Huygens eVLBI data from AU telescopes to JIVE (NL) involved 9 organisations & 3 continents*

- Fundamentals & lessons learned
- Human Factors
- Telemedicine as an exemplar
- Persistent Infrastructure
- Teleimmersion
- Other TEIN2 Collaborative Applications



# Good Networks aren't enough

– *"necessary but not sufficient"*



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- Well supported networks **without compelling applications** that provide new/enhanced opportunities for research, education and societal benefit are of doubtful value
- Need an **enthusiastic user base** and **champions** that have the **tools and capabilities** to **exploit** the opportunities presented
- Need a **framework** that ensures that applications benefit researchers, educators and society in a powerful, reliable and easy-to-use way
- The underlying complexities of the routing/switching infrastructure and collaboration tools should be **transparent** to the end users

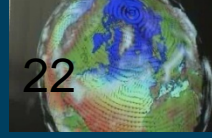


# Technical elements to be addressed

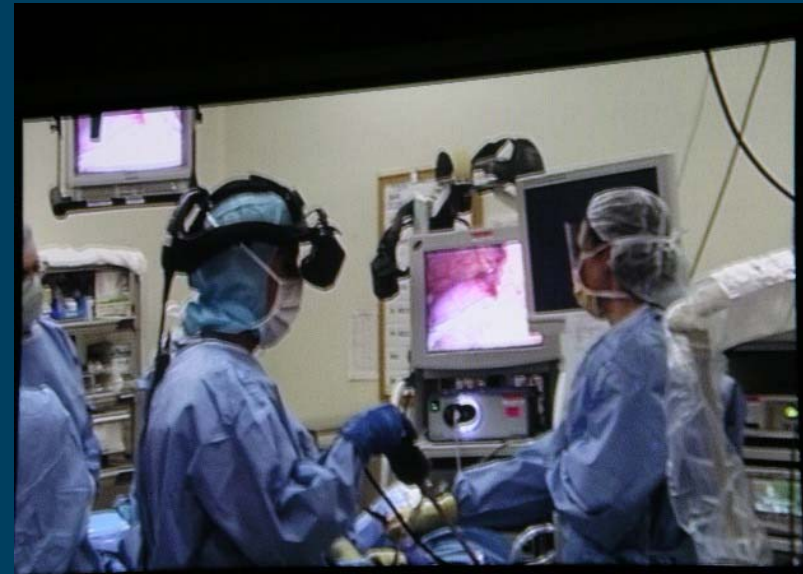
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- Network reach, reliability, low latency
- Routing/switching stability and predictability, resilience
- End-to-end performance across NRENS, campuses and end-user equipment
- Good cooperation between Network Operation Centres
- Good cooperation with regional and global exchange points
- Consistent support for collaboration tools
- *All of the above should be transparent to the end user*

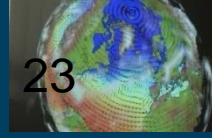
# "People" elements to be addressed (i)



- Identify enthusiastic "champions" within the research disciplines who have the vision to see what can be done with the infrastructure
- Encourage productive engagement between network engineers, researchers/users, performance and audio visual experts
- Understanding of "Human Factors" is essential
- If the "new way" of doing things isn't intuitive to practitioners
  - less likely to adopt
- If counter-intuitive.....!!!

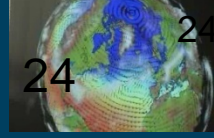


# "People" elements to be addressed (ii)



- Engage a "broker" – someone who "speaks" science/research and understands how networks can help
- Educate - make users aware of the possibilities and opportunities
- Invest in demonstrators and exemplars – but make the environment persistent
- Run targeted workshops in identified disciplines with both scientists/researchers, network engineers, and others
- Develop strong relationships with user communities
- Encourage the user communities to take the lead





# Telemedicine – a perspective

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*Dr. Devi Prasad Shetty, prominent Cardiothoracic Surgeon, Philanthropist.*

- “In terms of disease management, there is 99% possibility that the person who is unwell does not require an operation
- “If you don't operate you don't need to touch the patient
- “and if you don't need to touch the patient, you don't need to be there.
- “You can be anywhere, since the decision on healthcare management is based on history and interpretation of images and chemistry ...
- “... so technically speaking, 99% of health-care problems could be managed by the doctors staying at a remote place - linked by a telemedicine environment”





# The power of telemedicine as an exemplar



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- Lends itself well to exploitation of networks and technology
- eg Keyhole surgery involves a DV camera as part of the procedure – transmitting DV signals across networks allowing remote observation & questions provides a disruptive change to telesurgery training/mentoring
- Same applies for remote diagnostic immersive environments for patient consultation & assessment; nurse/medical training, case discussions, etc
- Access to specialists, and delivery of complex procedures over vast distances
- The collaboration tools can be redeployed for tele-immersive collaboration in other disciplines



# Telemedicine APAN Manila, January 2007



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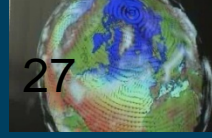
*During the APAN meeting in Manila, January 2007, demo'd live telemedicine (including live surgery) between all TEIN2 partners plus India and the US. Involved 12 countries and ~100 people  
- DVTS and IqV6 multicast now deployed across all TEIN2 member NOCs*

- **Beneficiary partners**
  - Indonesia
  - Malaysia
  - Philippines
  - Thailand
  - Vietnam
  - China
- **Non-beneficiary partners**
  - Korea
  - Singapore
  - Japan
  - Australia
- **Others**
  - India
  - US



# Why persistent infrastructure matters

- Demos are key to showing capability
- Usually require huge support and implementation effort
- Generally last from hours to a few days then “torn down”
- Need a framework that gives a persistent capability, and exploits the effort put into the demos
- NPH example



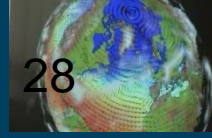
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*Bird Flu– 64 people, 8 countries*

*Virtual Surgery – 37 people, 5 countries involved*

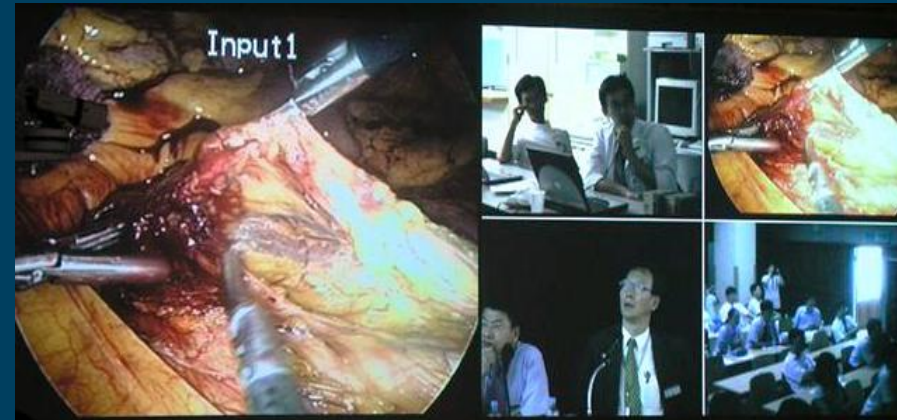
*Surgical Training Centres – 35 people, 5 countries involved*

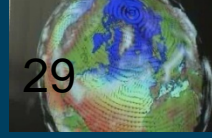




# Tele-immersion –what it provides

- Delivery of complex procedures between distant locations
  - Training, mentoring & planning complex procedures
  - Remote consultation, assessment, follow-up
  - Multidisciplinary case discussions
  - Access to specialists who might be thousands of miles away
- Needs to be highly interactive with low latency, low jitter, like being in the same room
  - Often involves complex information spaces, eg multidimensional images





# Telemedicine using High Definition

- At launch of new JP-KR 10Gbps circuit in March 2007 a demo of live surgery was performed using uncompressed HDTV (1.5 Gbps)
- A difficult keyhole surgery operation was performed in Seoul hospital
- High definition live stream of the surgery and the operating theatre “beamed” to a conference of surgeons in Kyushu, Japan – able to ask the surgeon questions during the procedure
- Video-stream was also viewed by a workshop of network engineers at a different venue
- Powerful demonstration of how high capacity networks allowing medical practitioners at different locations watch in HD and participate remotely in a procedure with incredible definition.
- Show video



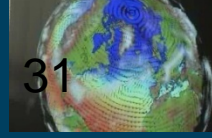
# Other collaborative applications (TEIN2)



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- Natural Disaster systems – typhoon tracking, flood, tsunami and earthquake warning/prediction/monitoring
- Climate change, meteorology, environmental monitoring
- Link with Grid initiatives, computing and data repository sharing
- Emerging infections (bird flu, SARS)
- Bio-informatics, Agro-informatics, Astronomy, eVLBI
- E-learning
- Preservation of Digital Heritage (ADHX)

*Important to prepare portfolios of applications & collaborations using the networks to illustrate the wisdom of the investment by funding agencies*



# Satellite and in-situ sensors

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- Huge explosion in volume of data being collected from satellite, terrestrial and oceanographic sensors
- ALOS satellite alone collecting a terabyte/day
- Data has to be stored in repositories, curated, accessed by different communities, analysed, visualised and used for predictions and modeling
- Increasing emphasis on (eg) climate change, disaster and natural hazard warning/monitoring systems, emerging infections and biosecurity require innovative exploitation of high capacity networks to maximise the benefit of massive amount of data coming on-stream.

# Applications Framework

## Contributions Summary

<http://www.tein2.net/server/show/nav.1862>



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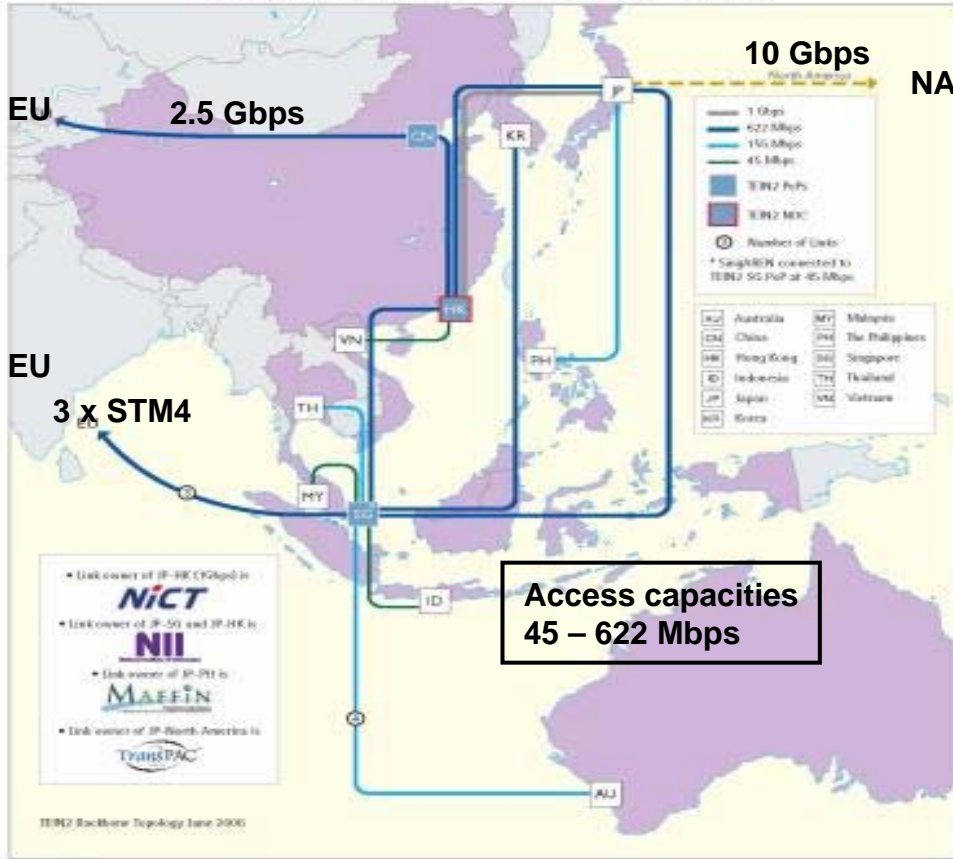
- **Telemedicine** entry lists 14 activities. All TEIN2 partners involved in at least one activity, most involved in several and some involved in up to 10. Most activities involved several simultaneous partners (often 4 or 5)
- **Emerging Infections** entry lists only one activity but involves 9 partners
- **TeleTeaching** entry lists only one activity between two partners. Many more examples to add.
- **Meteorology and Climate** entry lists only one entry between two countries, though various presentations indicate there is more going on
- **Digital Heritage** entry lists 3 activities with 5 partner countries involved. There are likely to be quite a few more than this
- Many other entries yet to be added, including grid-related activities



# TEIN2

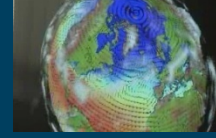
## Regional Connectivity for Asia-Pacific Research and Education

Linking Asia-Pacific to Europe and beyond



TEIN2 is co-funded by the European Commission through the European Union Co-operation Office

www.tein2.net



## International Research Networking

**TEIN2 network started Jan 2006, now connects:**

- 30million researchers and students
- 4000 institutions
- 10 countries

PoPs in Singapore, HK and Beijing; NOC in HK

Funded to Sept 2008, then.....





## ...TEIN3 Network project!

- European Commission has approved funding to end 2011
- Extend to South Asia
- Further support for application development
- Transfer TEIN3 programme to Asian ownership
- Plan for 'TEIN4'



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# Timezones and Populations

### TEIN2:

Member countries represent 1/3 of the world's population in a timezone range spanning only 3 hours

### TEIN3

Potential member countries represent almost 60% of the world's population in a timezone range spanning only 5 hours

Small timezone range is critical for interactive collaboration





# TEIN3 Network Topology

- To be determined from the tender results (not pre-defined)
- Current TEIN2 hub locations to be reviewed
- Europe-Asia links going West from Asia, likely to be 622Mbps, 2.5 or 10 Gbps
- Intra-Asia links likely to be in range 155Mbps to 10Gbps depending on partner needs, affordability by project and partner, and topology requirements (cost for some countries still currently very high)

# Tender Timescales



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April 2008:

- Contract Notice published in EU Official Journal and on DANTE website

May 2008:

- Initial tender documentation sent to interested organisations

June – Sept 2008

- Tender discussions and negotiations (timetable subject to tender procedure adopted)

September/October 2008

- First Contracts awarded

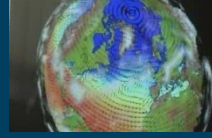
January 2009

- TEIN3 network starts service



## In conclusion

- Bringing large data sets together with teams developing modelling and forecasting tools and techniques is important for both commercial organizations, as well as the academic community
- The gains to understanding consumer behaviour in a global economy will arise from analyzing real problems with realistically large data sets which capture the variety in human responses.
- Access to large databases distributed across the world is a characteristic of many of the global collaborations - while the collaboration determines the endpoints of the network, the best-performing route depends on the match between the application and the network's characteristics
- The TEIN2, TEIN3 and APAN network communities would like to contribute to the collaborations catalysed by ISGC and EuAsiaGrid



# Questions?

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