Big-think strategies
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Innovation networks:
where e-science and telecoms meet

An unofficial and confidential report by an informal group of international telecoms experts

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1. INNOVATION NETWORKS: WHERE E-SCIENCE AND TELECOMS MEET

In previous papers, the international expert group has addressed issues such as smart grids, e-health, and tele-education as some of the key communications-based benefits, the achievement of which can enable and motivate very significant policy changes to US telecoms environment. None of the key issues in our society such as climate change, health care and education can be solved by telecoms. However, none of these Big issues can be solved without telecommunications.

Once true open networks are established, "cheap broadband" can be made available to all users. This will likely have effects similar to cheap oil had on the national and international economies after WWII, with the critical differences that (a) broadband *per se* doesn't pollute (although increased telecoms intensity can increase demand for electricity) and (b) broadband doesn't run out.

The current vertically integrated structure of the telecoms industry interferes with using the national telecoms infrastructure to generate the full range national economic and social benefits that can be delivered over that infrastructure to all people.

Over the last 20 years we have built extremely well developed 'backbone' systems for health care, education, science, etc. However, what is missing is both strong links to end users and strong links among many practicing physicians and clinics, which, unlike large hospitals, are effectively treated as "small" businesses by incumbent telecoms providers and therefore not accorded the investment and attention they need. Establishing these links will unleash the potential for a truly massive transformation of economic and social structures.

Establishing broadband links to end users (including small businesses) as part of a targeted deployment of smart grids, e-health capabilities, and tele-education is, in essence, a process that will enable the democratizing not only the power, health care, and educational systems – which to a large extend have become ivory towers, with their own surrounding fiefdoms – but also, over time, society as a whole. By allowing widespread access into these fiefdoms, and facilitating true interactivity between producers, scholars, and end users, true changes can be made that will see the development – over the next 25 years – of a more robust and flexible economic and social structure surrounding these disciplines, and more broadly, both nationally and internationally.

We hope that this paper presents some ideas for what an American national research, education and innovation network could look like. For the first time in more than a generation the model of unregulated speculative financial capital has shown that it cannot be relied upon even to provide stability and growth within its own sector, much less to provide sustained and meaningful support for long-term societal investment needs and goals. We can only hope that the new Administration will begin to explore new ideas.

2. E-SCIENCE

The following information comes from the ICTRegie (the Netherlands ICT Research and Innovation Authority) Strategic Plan 2005-2010: '*Towards a Competitive ICT Infrastructure for Scientific Research in the Netherlands*'.
http://www.ictregie.nl/index.php?pageId=6&l=en&personeelId=&pubId=15

E-science refers to a worldwide development to bridge the gap between scientists in application domains and the developments of ICT. E-science comes in different flavours, but the common goal is to make the most efficient use of the very fast developing ICT infrastructure in all fields of science and research. The following three lines of action can be distinguished.

- The Virtual Laboratory line is developing software (middleware) providing generic e-science services and generic application-domain oriented services. Examples of generic e-services are workflow management, metadata management and knowledge extraction, content access and browsing, reasoning technologies, and security services. Examples of generic application-domain oriented services are found in areas like bioinformatics, medical informatics, and food informatics.

The project involves researchers from public organizations (universities and other research organizations) and private organizations (Philips, Unilever, IBM, LogicaCMG, FEI).

- The computational science line is the field of study concerned with constructing mathematical models and numerical techniques and using powerful computers to analyse and solve complex scientific and engineering problems. The vision is to advance innovative, interdisciplinary research where complex multi-scale, multi-domain problems in science and engineering are solved on distributed systems, integrating sophisticated numerical methods, computation, data, networks, and novel devices.
- The third line of action is the human and digital interface to end users, including various facilities for visualization. Researchers with clear or partly articulated computational problems in their field need highly skilled personnel to understand and address their issues and provide real and practical solutions.

The prototype services need to be further developed, both to provide better support for the research areas for which they were developed and to broaden their scope to include other research areas. In order to provide the scientific community with stable and reliable products, research activities need to be complemented by (industrial) software engineering development and operational support.

3. CITIZENS E-SCIENCE

Widespread citizen science, and widespread, multi-nation collaboration are apt to lead to developments that would not have happened, or at least not as fast, as when science was done by a tiny few, separated from each other by time, space, language, secrecy, etc. This is not a "wisdom of crowds" point, but a "stand on the shoulders of giants" point. The result of joint collaboration can often be more than the sum of individual contributions, and modern technology and widespread, albeit not universal literacy help increase the ease of collaboration and thus the likelihood that it does occur.

Resources and attention to promoting the process, like a "science network" makes eminent sense in this context. Let's make it even easier for our best and brightest to collaborate.

In an open broadband environment, a science initiative will allow us to bring supercomputing to end users. These end-users can participate in virtual laboratories, and collaborate over high performance distributed computing, using the web and the grid. This is already happening, in a way; we already see NASA utilising the power of over a million ‘very professional amateur’ astronomers scattered all over the planet. Imagine if that idea is expanded into the other areas of science and education. A common aphorism among technology companies is that “most of the smartest people in the world work for someone else.” This recognizes that no matter how talented a particular organization might be, no one organization can ever hope to employ all, or even most, of the truly talented and innovative people in its field. Now imagine what this means on a national or worldwide scale: an e-Science initiative combined with real open broadband can help harness the talents of hundreds of millions of people nationwide and worldwide. The amount of innovation that will take place in this dynamic field of interaction is simply mindboggling.

Exhibit 1 – Many Eyes – e-science web site

The web site was launched in 2007 and was created by US scientists to help people publish and discuss graphics in a group.

People can share more technical types of displays: graphs, charts and other visuals they create to help them analyse data buried in spreadsheets, tables or text. With an experimental Web site, Many Eyes, users can upload the data they want to visualize, then use sophisticated tools to generate interactive displays. These might range from maps, relationships in data bases or publications, displays of the comparative frequency of words used in speeches, etc..

Those who register at the site can comment on one another's work, perhaps visualizing the same information with different tools and discovering unexpected patterns in the data. It offers 16 ways to present data, from stack graphs and bar charts to diagrams that let people map relationships. TreeMaps, showing information in colourful rectangles, are among the popular tools. One tool, called

an interleaved tag cloud, lets users compare side by side the relative frequencies of the words in two text passages.

Almost all the tools are interactive, allowing users to change parameters, zoom in or out or show more information when the mouse moves over an image. Users can embed images and links to their visualizations in their Web sites or blogs, just as they can embed YouTube videos.

See also: *www.many-eyes.com*

The importance of e-Science development is illustrated by the fact that the Dutch government has declared that the underlying infrastructure of the country's Gigaport project – SURFnet – will be seen as a national infrastructure project and be regulated and funded accordingly (no longer a science project – which often depends on 'handouts' on a year-by-year basis). This will certainly spearhead the project into the wider community. The project has been lifted from its scientific cradle into the broader Dutch community.

Exhibit 2 – Gigaport and SURFnet

GigaPort consists of two interrelated sub-projects, GigaPort-Network (managed by SURFnet, the Netherlands' research and education network) and GigaPort-Applications (managed by Telematica Institute). Within the context of GigaPort-Network a highly advanced research communications network is being developed with super-fast connections across the Netherlands and Europe and to North America and Asia. GigaPort-Applications offers the Dutch academic and business community the opportunity to carry out large-scale research into new applications for the next generation of the electronic highway.

For more information: *www.gigaport.nl*

Other countries, including the USA, need to be able to craft national policies that transcend the silos of science, telecoms, healthcare, education and so on. True whole-of-government policies are required to break through these silos. Given the scale and scope of the required effort, only governments can provide the level of leadership needed to get us there. The benefits of this initiative do not accrue to any one private entity, so no private entity will have the incentive to get the job done.

Interestingly, there is already a significant amount of international cooperation and collaboration taking place. However, in countries like the USA it seems to be far more difficult to also establish a more cohesive and collaborative national approach.

The power of citizen science has also spread to China. The Economist predicts at least one entirely new species of bird will be discovered in China in 2009, because China now has an active, amateur, bird-watching community

4. FROM VIDEO TO VIRTUAL KNOWLEDGE

The industry newsletter The Cook Report (LINK) recently featured comments from Harvey Newman. Harvey is the architect and one of the principal builders of the global optical network that will collect the data for the Large Hadron Collider. The interview concentrated around the statement "*The focus on video as the motivation for true broadband [must be] temporary*."

The following is an abstract of that interview.

"Network applications involving access to, and sharing of large volumes of binary data as the basis of information, and ultimately as a basis of knowledge, are highly developed, but are not so visible in the world of entertainment and social networking, as they are in the realm of research. But soon corporations will learn to follow in the footsteps of the research community to handle and benefit from the knowledge implicit in such datasets, whether for healthcare or for other business processes, or for new forms of education, that complement web-page and video (more traditional) 'content'.

Even in the days when walls of your home are live displays (the walls themselves, as extensions of current OLED developments, not just screens), it will be the knowledge behind the images, and the ways they are used to inform and educate, as well as entertain, that will matter most."

The possibilities are profound. These developments include hybrid optical networks that will send light paths across heterogeneous network boundaries. There is a lot more work to be done – work that will take another four to five years. But when it is finished fiber-connected end users will be able to use a GUI interface to build light path networks that will operate as a part of their application.

And there is no reason why, if the issues of authorization and authentication are solved, these optical hybrid networks could not be available almost universally. TCP/IP would be used much less, less electrical energy would be needed and – for the first time – the infrastructure would exist on which companies could truly deliver the world's knowledge. This is currently happening in the Netherlands (Gigaport) and in Japan. Will it happen in the US? Only if the new administration accepts that open access dark fiber has to be a part of any new telecoms policy moving forwards.

The Expert Group

This report has been produced by an international team of telecommunications experts from the following countries: America, Australia, Canada, France, Germany, Japan, Netherlands, New Zealand, Sweden and the United Kingdom.

This group is composed of strategists, economists, lawyers and attorneys, technologists, representatives of national and international telecommunication organisations and telecommunications company directors.