SILK PROJECT DESCRIPTION

INTRODUCTION

The ancient Silk Road was not only a trade route but also an all-important road for the transfer of information and knowledge between major regions of the world. The project presented below plans to bring highly cost effective, global Internet connectivity to the Caucasus and Central Asia through state-of-the-art satellite technology, thus creating a virtual Silk information highway. Consequently, the project has been called the 'Virtual Silk Highway', in short: the 'SILK Project'. The aim of the SILK Project is to increase significantly the exchange of information with, and between, academic and educational institutions in these regions.

The Advisory Panel on Computer Networking (the Panel) has taken the initiative to launch the project. Since 1994, the NATO Science Programme, advised by the Panel, has been one of the major supporters of academic networking in the regions, helping to create an appropriate infrastructure. This support has had, and continues to have, a very high impact on the communication needs of the scientific community. The improvement of the terrestrial infrastructure has now made the regions more dependent on basic Internet connectivity for research and education. The Panel realises that the provision of Internet connectivity is not research; however access to it is the most effective tool available today to access and release the research potential of talented, highly educated people, trained in science and technology.

Additionally, Internet access can promote availability of content and information and thus contribute to open societies, democratic processes and the improvement of education. Closing the gap between information-rich and information-poor societies is expected to promote peace and security.

During recent years the main target areas of the Panel have already been the Southern Caucasus, comprising the countries of Armenia, Azerbaijan, Georgia, and Central Asia, which includes Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. These countries are located on the fringe of the European Internet arena and will not be in reach of affordable optical fibre connections within the next few years. However, Internet connectivity via satellite is an expensive, and therefore a scarce, resource for the science and education community in these countries. As a result the bandwidth available for the whole research and educational community in these countries ranges from 64 Kbps to 384 Kbps.[1] The proposed project will increase the average rate for each country to 3 Mbps (Megabits/second) by 2004.

A considerable proportion of the Computer Networking budget is currently devoted to Networking Infrastructure Grants (NIG) which fund recurring costs of Internet connectivity. As the Panel's funding possibilities are very limited; this new initiative is designed to make these funds stretch further by providing a cost-effective but expandable system covering these regions. There is the additional corollary to the approach adopted,

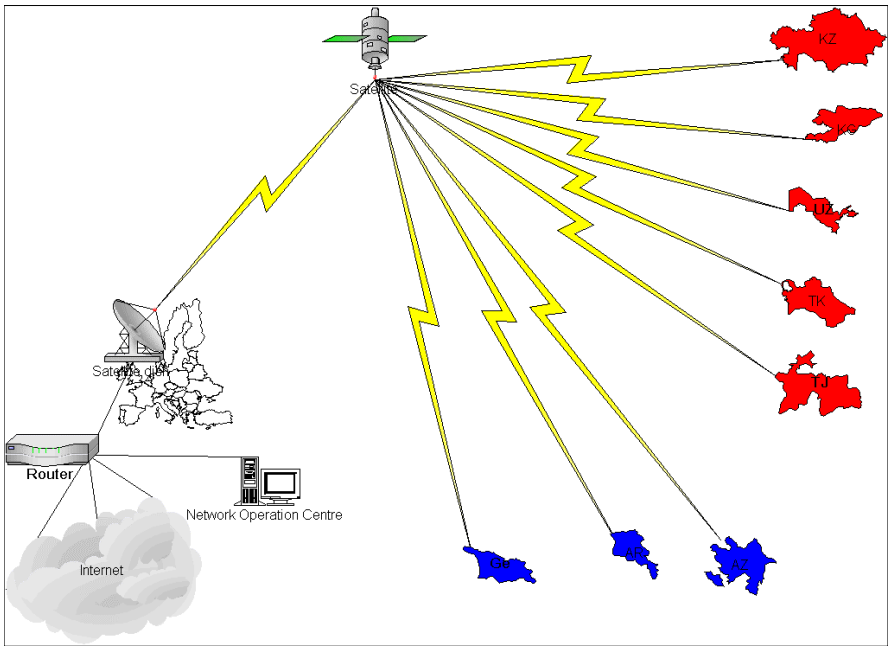
[1] For comparison, an average West European home connection to the Internet is at least 56 Kbps, for one person, and many are an order of magnitude faster.

that maximum advantage to each individual country will come from collaboration. Only by strengthening National Research Networks will there be better use of the international infrastructure.

PROJECT CONCEPT

The academic and educational communities in the eight countries in Central Asia and the Southern Caucasus will be connected to the Internet by way of a common satellite beam. New technology makes it possible for each of the eight countries to have its own minimum bandwidth capacity and at the same time make use of unused bandwidth of other participating countries. In addition, the use of modern data caching techniques, enabled by the choice of satellite technology, should allow further improvement in the effective bandwidth achieved.

The configuration that is necessary to achieve this goal consists of satellite dishes and network equipment in the eight countries, a central distribution point (hub) with a dish and network equipment in Western Europe, a contract with a satellite vendor, and Internet access. These components are shown schematically in the following figure:



Schematic of the Silk Satellite Topology

Next to the components mentioned above, attention must be given to managerial issues, in the West as well as in the receiving countries, if the project is to be a success.

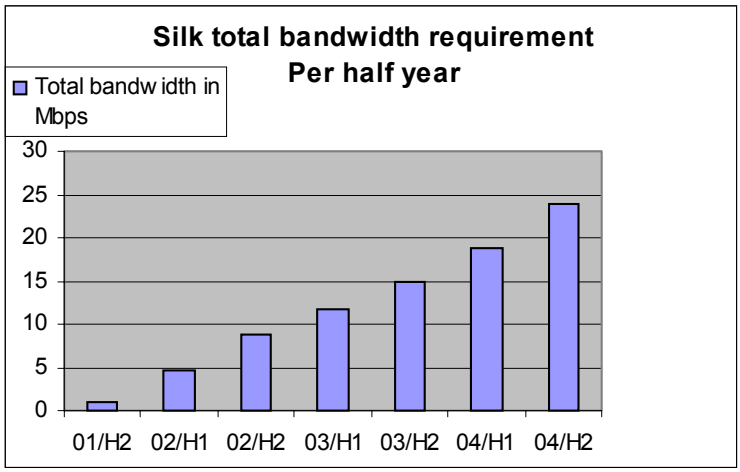
For the realisation of this concept, it has been necessary to define the functional specifications of the whole system, contact vendors for quotes of the various components and, after selection of vendors, produce a detailed implementation plan, including the total cost of ownership, and sustainability provisions.

SELECTION PROCEDURE

Funding Constraints A prerequisite for the project initiation was the Science Committee's agreement, in October 2000, to maintain the level of funding of the Computer Networking activities at its current level for the years 2002 - 2004 [AC/137-DS(2000)3]. Once this was clear, the Panel set up the Silk Task Force to explore the feasibility of the concept mentioned above.

Approval by Panel In March 2001 the functional specifications of the system were presented to, and approved by, the Panel. A market survey, carried out at that time, indicated that $2,500,000 would be needed for the realisation of the project. Most of this budget is necessary for the satellite connectivity and it is therefore obvious that the costs of this component will determine the cost effectiveness of the whole project.

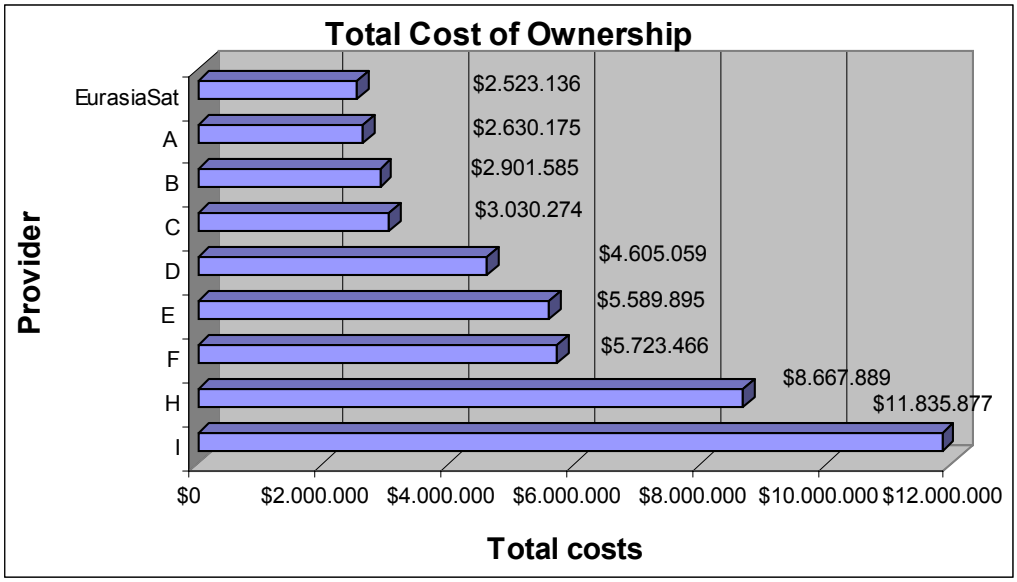
Discussions with Satellite Providers As a next step, potential satellite vendors were contacted for quotes. In order to compare the various quotes the Silk Task Force calculated the affordable increase of bandwidth during the project period on the basis of the indicated budget. The following graph presents the projected bandwidth growth for the whole region:



The left-hand side begins in October 2001 with 1 Mbps and the right side stops in December 2004 at a total bandwidth of 24 Mbps. In this graph there is an annual growth of 1.55 each six months. This bandwidth profile was used to compare the offers from various satellite vendors.

Formal Quotations from Satellite Vendors Various satellite vendors were approached with a description of the service that was required and were asked for a quote of either raw bandwidth or the price of a turnkey solution. In June 2001 the results of the tender were presented to the Panel. An objective and comparable overview was achieved by calculating the total cost of ownership of the various options that resulted from the quotes. The total cost of ownership consists of all investments for infrastructure and of operational costs that would be needed from NATO funds during the project period.

The following comparison demonstrates that only two options are within reach of the indicated budget.



(The names of the providers have been omitted as this information is confidential).

EurasiaSat owns the newly launched (January 2001) satellite 'Eurasiasat-1/TurkSat-2A'. The second candidate (A) can start normal operations only in 2003. This, in addition to minor differences in cost, led us to choose the EurasiaSat bid.

OVERVIEW OF THE INDIVIDUAL COMPONENTS AND COSTS OF THE SILK PROJECT

Total Costs and Budget. Further negotiations with EurasiaSat and vendors of other facilities and services have led to the following profile of the cost of ownership.

EurasiaSat with KALITEL DAMA electronics, 8PSK EurasiaSat (05/11)					P&L
Year	**2001**	**2002**	**2003**	**2004**	**Total**
Operational expenses	$ 75.740	$ 366.828	$ 548.764	$ 742.020	**$ 1.733.351**
Investments	$ 1.288.268	$ 329.474	$ 102.237	$ -	**$ 1.719.979**
Budget requirement	$ -1.364.008	$ -696.302	$ -651.001	$ -742.020	**$ -3.453.330**

Breakdown of Expenditure by Year

In this overview the desirable bandwidth has been adjusted to needs that were expressed during discussions of the project with the various Partner countries. This has led to higher bandwidth needs than those first anticipated. Each of these elements can be broken down, of course.

Operational Expenses The Operational Expenses consist of the costs of satellite connectivity (EurasiaSat), Internet connectivity, hardware and software support, housing costs of the hub, installation costs and management. A more detailed overview of these costs is listed below:

Operational expenses	2001	2002	2003	2004	Total	
Project Management	$ 10.000	$ 30.000	$ 30.000	$ 30.000	**$ 100.000**	
User support and training	$ 10.000	$ 10.000	$ 10.000	$ 10.000	**$ 40.000**	
Space segment (500 Mbps-months)	$ -	$ 151.033	$ 328.784	$ 516.540	**$ 996.356**	
Internet Service Provision	$ 5.000	$ 30.000	$ 40.000	$ 50.000	**$ 125.000**	
Marginal cost of Mbps-month						***$ 2.243***
Hub operation	$ 10.000	$ 70.000	$ 70.000	$ 70.000	**$ 220.000**	
Operational Management and Support (NO	$ 10.000	$ 40.000	$ 40.000	$ 40.000	**$ 130.000**	
Cisco support	$ 12.740	$ 22.295	$ 25.480	$ 25.480	**$ 85.995**	
Cisco installation	$ 18.000	$ 13.500	$ 4.500		**$ 36.000**	
Total	**$ 75.740**	**$ 366.828**	**$ 548.764**	**$ 742.020**	**$ 1.733.351**	

Breakdown of Operational Expenses by Year

Investment Costs The Investment costs are those for the infrastructure of the dishes and network equipment (at the hub and in the receiving countries). These costs are broken down below.

Investments	2001	2002	2003	2004	Total	
European node					**$ 649.320**	
Network equipment (Cisco)	$ 28.000					
Hub antenna	$ 139.363					
Hub DVB system	$ 113.562					
Hub redundancy	$ 90.275					
8PSK Hub Upgrade	$ 67.102					
Hub DAMA equipment + management soft	$ 149.241					
Factory services and hub installation	$ 61.777					
Management softw./hardw.						
Local nodes					**$ 804.659**	
Uzbekistan Cisco	$ 45.500					
Satellite earth station	$ 52.237					
Kyrgyzstan Cisco	$ 45.500					
Satellite earth station	$ 52.237					
Georgia Cisco	$ 45.500					
Satellite earth station	$ 52.237					
Armenia Cisco	$ 45.500					
Satellite earth station	$ 52.237					
Tajikistan Cisco		$ 45.500				
Satellite earth station		$ 52.237				
Kazachstan Cisco		$ 45.500				
Satellite earth station		$ 75.000				Kz needs 3.5m d
Azerbaidjan Cisco		$ 45.500				
Satellite earth station		$ 52.237				
Turkmenistan Cisco			$ 45.500			
Satellite earth station			$ 52.237			
Cisco installation	$ 18.000	$ 13.500	$ 4.500		**$ 36.000**	
Spare parts	$ 130.000				**$ 130.000**	
Unpredictable	$ 100.000				**$ 100.000**	
Total	**$ 1.288.268**	**$ 329.474**	**$ 102.237**	**$ -**	**$ 1.719.979**	

Breakdown of Investment Expenses by Year

Selection of the Hub and Related Costs One of the issues that had to be explored further was the location of the European hub. While the Silk Task Force had an open mind on this matter, a study of the tenders showed that an academic institute would be preferable, both on economic and flexibility grounds, to commercial sites. In particular, DESY (Deutsches Elektronen-SYnchrotron) in Hamburg offered to host the European hub. DESY has had long experience in providing satellite services to several countries of the former Soviet Union, a number of which were (co)-funded by NATO grants. Investigation has shown that other locations with comparable quality, experience and pricing do not exist. The costs of the European hub being situated in Hamburg have been calculated on the basis of the costs for infrastructure as well as for operational costs.

Additional Sources of Budget As well as the NATO budget, other venues were explored for co-funding. Firstly, Cisco Systems has offered to donate the network equipment and installation costs in the local nodes in the Partner countries; Cisco's contribution to the project is estimated at $400,000. Secondly, DESY is willing to pay for the technical management (indicated below), Internet connectivity and housing costs of the system if the hub is situated in Hamburg. The housing costs consist of the parcel of ground that is needed for the satellite dish and heating and power requirements; it also includes the network connectivity facilities. The Internet connectivity will be routed through the existing DESY connection to DFN (Deutsches Forschungs-Netz) as the Internet Service Provider (ISP). There will be no charge for this use of DFN's access lines to the European Research Internet, which is valued at $ 125,000. Overall DESY's contribution to the total costs of the project is estimated at $ 475,000. Given this co-funding the total financial overview is presented in the following table.

EurasiaSat with KALITEL DAMA electronics, 8PSK **EurasiaSat (05/11)**					**P&L**
Year	**2001**	**2002**	**2003**	**2004**	**Total**
Budget requirement	$ -1.364.008	$ -696.302	$ -651.001	$ -742.020	**$ -3.453.330**
Grants					
NATO	$ 730.000	$ 750.000	$ 520.000	$ 500.000	**$ 2.500.000**
Cisco Systems	$ 200.000	$ 150.000	$ 50.000		**$ 400.000**
DESY	$ 20.000	$ 110.000	$ 110.000	$ 110.000	**$ 350.000**
EU					**$ -**
DESY DFN access	$ 5.000	$ 30.000	$ 40.000	$ 50.000	**$ 125.000**
Project Management	$ 10.000	$ 30.000	$ 30.000	$ 30.000	**$ 100.000**
User support and training	$ 10.000	$ 10.000	$ 10.000	$ 10.000	**$ 40.000**
Site preparation and licencing	$ 2.000	$ 15.000	$ 5		**$ 17.005**
Total grants	$ 977.000	$ 1.095.000	$ 760.005	$ 700.000	**$ 3.532.005**
Liquidity	$ -387.008	$ 11.690	$ 120.695	$ 78.675	**$ 78.675**

Breakdown of Income and Expenditure by Year

Cost Benefits of the Project A survey, that was executed at the beginning of 2001, showed that Research and Education in five of the eight countries is currently receiving a total of approximately 1 Mbps bandwidth at a yearly cost of $230,000; there were no

reliable figures available for the other three countries. The same amount of receive bandwidth costs approximately $ 75,000 per year in the EurasiaSat proposal listed above.

Recommendation by the Panel The Silk Task Force has advised the Panel to allocate the budget and implement the project according to this scheme. The Panel, together with Cisco Systems and DESY, recommend this investment. Its provisions will allow the beneficiaries in Research and Education to improve their access to the Internet considerably for a certain period of time. In addition, the agreement with EurasiaSat allows for both Non-Governmental Organisations and the National Research and Education bodies to purchase extra bandwidth at the much-reduced cost of $ 35,000 per Mbps per year. The design of the total system allows considerable expansion of the system at marginal extra cost.

The scheme does not allow for any cost overruns during the project. If for some reason there are costs that are not covered by income from one of the donors, then funds will be made available by reducing the bandwidth that is being provided, or by pursuing additional external funding.

IMPLEMENTATION

The next phase is the actual implementation of the project and consists mainly of managerial and procurement procedures.

Dr. Hans von der Schmitt (Director for Technical Infrastructure, Development and Services of DESY) will be the NATO Country Co-Director and for each of the participating countries a representative of the NREN (National Research and Educational Networking organisation) will act as Partner Country Co-Director.

It is planned to implement the project in stages. At the beginning of 2002 Armenia, Georgia, Kyrgyz Republic, and Uzbekistan will be connected; to be followed by Azerbaijan, Kazakhstan, Turkmenistan and Tajikistan later that year. This sequence takes into account the most pressing needs for higher bandwidth and the different degrees to which functioning NRENs have been established in the various countries. During the implementation of the project it is certainly possible (and even expected) that licencing problems and site preparation duration will give rise to change the sequence.

A Policy Steering Committee will be set up to manage the project at the highest level. Its membership has yet to be settled finally and will be discussed with the Co-Directors at the first project meeting. It is expected that it will include a number of *ex officio* members; these will include at least one Panel member and representatives of any other funding bodies. It will include also the nine Co-Directors of the project from the NATO country and the participating Partner countries. The NATO Co-Director will ensure that the procurement of necessary equipment will be executed in a cost-effective manner.

The whole project plan has been predicated that the level of funding is assured until 2004; nevertheless, since the NATO Science Programme operates with annual budgets, the

contract with the satellite vendor will allow its termination on three months' notice towards the end of each calendar year – with minimal penalty.

The actual project management consists of technical and process management. DESY is providing the technical management (valued at $ 40.000 per year) covering the daily operation of the system (together with the support staff of the satellite vendor). A third, external, party should execute the process management. It is proposed to use the Silk Task Force for this activity, with the assistance of the regional NATO Computer Networking Consultants at the beginning of the project. As it grows, this activity will become more elaborate and it will become necessary to attract additional funding for a professional management. Various parties, such as the Soros Foundation, UNDP and the EU have already expressed their interest in making use of the higher bandwidth (Soros and UNDP) and in providing funding for management (Soros, EU).

It is foreseen that regional NGOs will want to make (non-commercial) use of the SILK infrastructure. This should be made possible on two conditions: any extra bandwidth that is necessary must be paid for in a separate bi-lateral agreement between the NREN and the satellite vendor, and the use of the connection must not violate the Acceptable Use Policy, which is being formulated. It will be one of the tasks of the Steering Committee to monitor these issues.

LONG TERM PERSPECTIVE

Of course the SILK project provides only a medium-term solution for the Internet connectivity in the selected countries. The NRENs will be expected in the coming years to develop sustainable financial structures for the continuous exploitation of the SILK infrastructure or other variants that become available. The NATO Advanced Networking Workshop (ANW) at Lake Issyk-Kul (Kyrgyz Republic) in September 2001 will be devoted to the problems related to this issue. High-ranking government representatives of countries taking part in the project have been selected as participants in the ANW together with the representatives of the NRENs.

While the $ 2.500,000 of NATO funds envisaged to be spent on the project comprises a considerable proportion of the Computer Networking budget, the Networking Panel believes it is money very well spent. It will result in other funds provided for the relevant countries being used in a much more effective manner.

RECOMMENDATION TO THE SCIENCE COMMITTEE

The Networks Infrastructure Panel recommends that the Science Committee notes the description of the Silk Project, and approves the release of funds requested.