ARTICLE

Internet Provision for Universities in Central Asia

Peter T. Kirstein
Deptartment of Computer Science, University College London

1. Introduction

This contribution summarises the progress towards *National Research and Education Networks* (NRENs) in the regions of the Caucasus and Central Asia during the period up to 2009. Many organizations joined in to help set up these NRENs. The United Nations Development Programme (UNDP), the Soros Foundation Opens Systems Initiative (OSI) and the World Bank were all active in particular countries. However NATO, under what was initially its *Science for Peace programme*, was the only one to operate across every country in both regions. I was deeply involved in this NATO programme, so that I may have overlooked major contributions from other sources.

This paper makes no attempt to cover the growth of commercial ISPs in the region; it deals only with that of NRENs. It gives, in Section 2, some background on the NATO activities in this area. It then discusses briefly, in Section 3, the first regional network in the area. That network covered also Russia, but that region is not the subject of this paper. As a result of programmes to set up NRENs in the different countries, a regional project SILK-1, was set up to provide international connectivity into the European NREN system GEANT. This project is described in Section 4. The SILK-1 project was entirely devoted to connecting existing NRENs into GEANT; it was not concerned with the development of the NRENs themselves. That development is overviewed in Section 5 for each country in turn. The original SILK-1 project was for three years of operation finishing in 2005. Because of the emergence of the critical importance of these regions, NATO agreed to an extension of SILK to 2009. This extension, SILK-2, is described in Section 6. Towards the end of SILK-2, the European Commission started two further projects to provide regional connectivity into GEANT. The first, for the Caucasus, was the Black Sea Interconnect (BSI) Project considered in Section 7; the second, the Central Asian Research and Education Network (CAREN) is mentioned in Section 8. In some cases, universities in the region continued with connections outside the framework of their NRENs; this matter is discussed in Section 9. The status of Afghanistan is ambivalent. It only sometimes is included to Central Asia. Since Afghanistan was already part of SILK-1, and developed further after SILK-2, it is discussed in Section 10. This development will still continuing at least up to 2013. in view of the general interest in IPv6, a brief discussion of that area is given in Section 11. Some conclusions are drawn in Section 12.

2. Background of NATO Involvement in the SILK Programme

When the Soviet Union disintegrated in the early ‘90s, many of the provisions which had come previously from the Central Soviet government fell into abeyance. This was the same period as the Internet first came into prominence world-wide, but no moves towards the internet were coming from the governments of the former CIS countries. It is because the early support for introducing the Internet in these regions came from Western sources that I am writing this account..

Since the early ‘90s NATO supported scientific collaboration between Western and Eastern researchers under the umbrella of the “NATO Science Programme”. This programme provided small research grants to former Soviet scientists in the areas of Physics, Life Sciences and the Environment. The purpose of the grants was partly to keep scientists working happily in their countries, as the impact and need for Internet access in academic research increased, it was logical to complement the scientific grants by a

networking programme. Thus an *Advisory Panel on Computer Networking* (NP) was set up under the chairmanship of Vint Cerf in 1994. I was a member of the NP until the end of 2001, being its chair in that year.

The NP gave grants, typically around $150K - $200K to various former Soviet Bloc countries to set up National Research and Education Networks (NRENs). By the late '90s, these were restricted mainly to the former Soviet CIS countries of the Caucasus (Armenia [AM], Azerbaijan [AZ] and Georgia [GE]) and Central Asia (Kazakhstan [KZ], Kyrgyzstan [KG], Tajikistan [TJ], Turkmenistan [TM] and Uzbekistan [UZ]). Each grant involved certain equipment for local area networks inside universities, routers and servers. They included also a small sum for 64 Kbps or 128 Kbps Internet access. Various Governmental and non-Governmental organizations made similar provisions in the region; there was virtually no national government contribution. Each grant had both a Western and a local co-Director, who oversaw the progress of the project and reported to the NP.

3. The DESY High Energy Physics Project

During the '90s, the German and Russian Governments, under the auspices of the German Electron Synchrotron Institute (DESY), funded a C-band satellite network to connect the High Energy Physics laboratory in DESY in Hamburg to a number of European Russian HEP centres. Later this was extended under the EC INTAS programme to include Yerivan (AM), Tbilisi (GE) and Almaty (KZ) outside Russia – and several Russian sites in Asia. The principal local scientists who started international network activities in these laboratories usually had links with either the Centre of European Nuclear Research (CERN) or DESY. These lead scientists from the Caucasus and Central Asian laboratories were Mkrtchyan (Armenia), Kvatadze (Georgia) and Boos (Kazakhstan). Its hub and Network Operating Centre (NOC) were in DESY. The NOC was staffed with Russians from Moscow State University (MSU) under contract from DESY. Berezhnev (MSU) ran this NOC group, and had a strong influence on its design.

In some cases the NP of Section 2 provided funding to existing projects in order to have them provide bandwidth also to projects funded by NATO. Some of the laboratories in the DESY project received such funding. In return for this funding they agreed to provide bandwidth to neighbouring universities via their High Energy Physics laboratory. In Armenia, Mkrtchyan had a substantial MAN covering Yerivan and the surrounding valley; in Almaty, Boos had links to several Almaty locations, but a Networks person wanted to be in charge. In Tbilisi, Kvatadze started a successful NREN from this small beginning. A diagram of this early network is given in Fig. 1. It can be seen that two of the nodes outside Russia were in the Caucasus and one in Central Asia. While there were several more in Russian Central Asia, I believe that the history of these is not part of the story that this book is telling. Outside Moscow, typical bandwidths were just 64 Kbps.

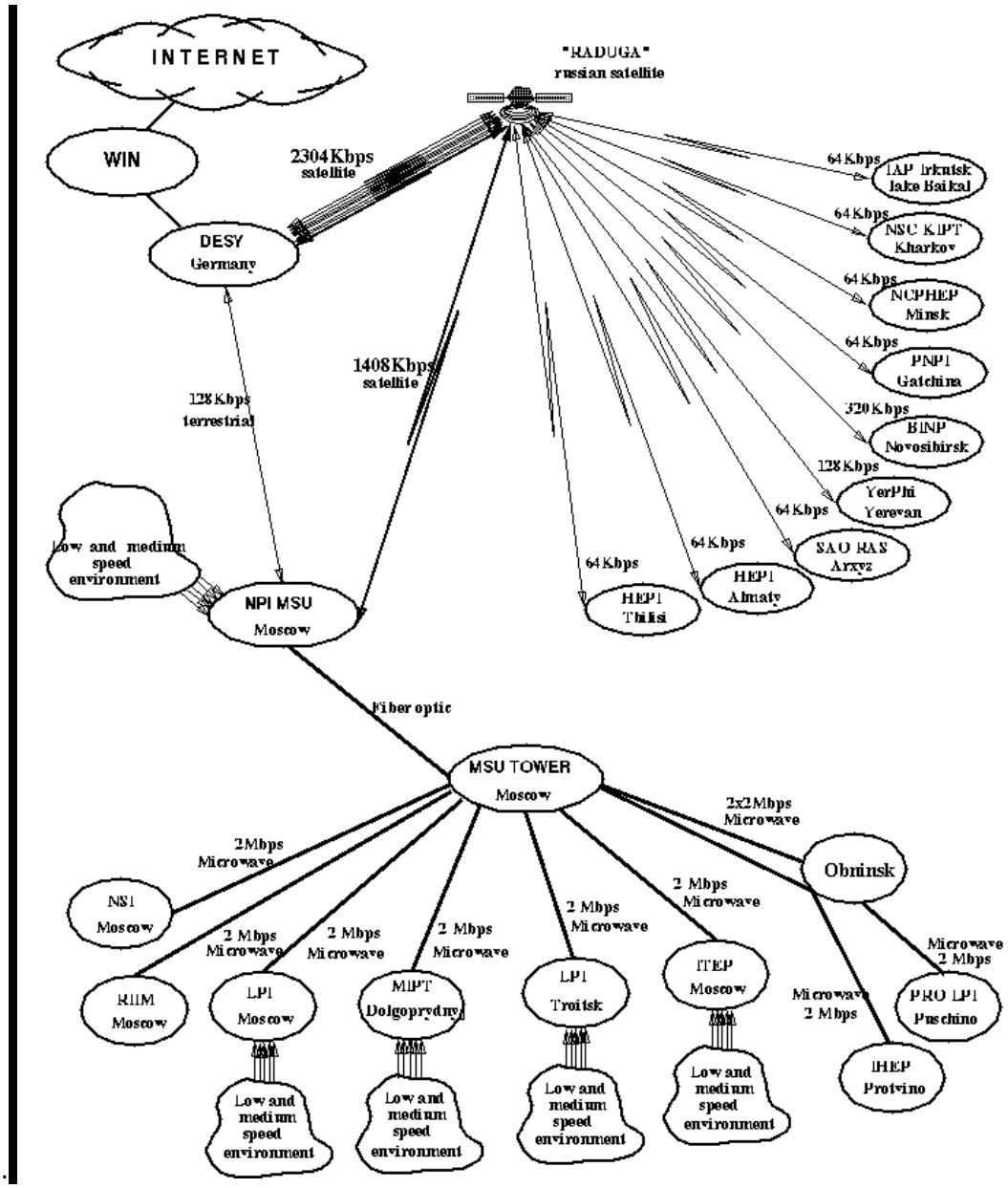

Figure 1 Schematic of the DESY HEP Network

4. SILK-1

During the early part of 2001, three of us Hans Frese (DESY), Robert Janz (University of Groningen, UoG) and myself (from University College London, UCL) decided this piecemeal approach to communications was inefficient and should be replaced by a regional project covering both the regions of the Caucasus and Central Asia. We saw, for example, that grants were given to Uzbekistan to support a 128 kbps Internet connection at the cost of $ 85,000 per year. The vision was that by joining forces in a regional approach we could achieve far better tariffs for Internet connectivity. We persuaded the NP, of which I was Chair, to forego 50% of their budget for four years, and NATO to fund a four-year programme to provide Internet communications for the regions. Cisco provided a router, switch and web cache to each republic, and we persuaded the European Commission (EC) to fund the management of the project. It was to run over the perid 2001-2005, and to provide three years of operation. The inaugural meeting of the new project, call the SILK Project, was at Lake Issyk Kul (Kyrgyzstan) on September 21, 2001 – ten days after the tragic event in New York.

The SILK Project was essentially to provide Internet connectivity to NRENs in the constituent countries [1] with one access node per country. It agreed to provide the same bandwidth provision for each country; we did not want to get into the political complexity of determining the fair criteria for sharing of capacity. A brief analysis of the international communications situation in 2001 made it clear that a satellite solution was the only feasible one at the time. As a result of a tender, a steadily increasing bandwidth of up to 27 Mbps (22 Mbps W→E and 5 Mbps E→W), 8 VSAT Earth-stations and the electronics for a VSAT hub were contracted from Eurasiasat. The earthstations came from Kalitel and were KA band ones. DESY agreed to run the VSAT hub, a team of Russian visitors at DESY ran the NOC, and Cisco donated the network infrastructure for the node in each location. The provision of an NREN was not part of the SILK Project. It was made the condition of receiving an access node that the country had an NREN, formulated an Acceptable Use Policy (AUP) and received transmission agreement from their National regulators. The German NREN (DFN) provided the Internet access. One of the early descriptions of the project (in German) was published in the DFN News [2]

We did not specify the extent of the NRENs. Indeed in most SILK countries it was restricted to the capital city (though in the case of KZ it was the former capital of Almaty, where most of its advanced universities were sited). A map of the location of the nodes is shown in Fig. 2.

Figure 2 The Location of the Nodes in the Silk -1 Project

The first node went live in October 2002 (Uzbekistan), and all of the original ones were operational by mid-2003. During the last year of the operation of SILK-1, in 2005, some NRENs co-funded additional bandwidth at a rate subsidized to 50% by the project. Also in 2004, an additional node was added in Kabul, Afghanistan (AF). While the modest 5/15 Mbps bandwidth for a whole country was even then ridiculously low, it was a huge advance on the 64Kbps or 128 Kbps that they had had previously.

During SILK-1, the NATO SILK support was only for the bandwidth and earth-station electronics. There was also some support for training workshops. The EC support for management covered travel to the regular meetings that were essential to make the project coalesce. By some donations from Cisco, a limited VoIP service was provided. Also with support from NATO some room video conferencing systems were established. Indeed, the videoconferences are used on a regular basis for management progress meetings, distance education and special events.

5. The start of the NRENs

By 2002, there were a significant number of NREN projects in the two regions started mainly by funds from the NATO NP. A snapshot of the status of the NRENs done under SILK-1 in October 2002 done under the EC-sponsored SPONGE project managing SILK-1 was followed by another in late 2005. Support for the NRENs was provided by the Open Society Initiative of the Soros Foundation (OSI), the United Nations Development Programme (UNDP) and others – in addition to NATO.

In summary, at the start of Silk-1 in 2002, there were almost no universities in either region connected to the Internet. By 2008, when the transition to other projects was starting, academics and researchers in 9 countries and 53 cities had Internet connectivity. In fact, 188 universities, 334 research institutes and 9 million people were so connected. This provided a vital basis for the later projects of Sections 7 and 8.

Armenia

In 2002, the there was only one institution directly connected, because of monopoly regulation issues. However, there was an extensive wifi network in Yerevan (before this was allowed in Europe, connecting the High Energy Physics Institute to other Physics departments. At the beginning of Silk-1, Armintel was very restrictive; a single room in such universities had to be designated as the Silk room. By 2005, there was a fibre infrastructure through the main cities, which allowed E1 links to be ordered. At that time there were E1 links from Yerevan to the other four principal cities in the country. There were 34 institutions connected. It was hard to get any government support for their universities until 2008. The Armenian Academy of Sciences was always somewhat separate until that time.

Azerbaijan

In 2002, there were local networks in some four institutions, and elaborate plans for an NREN. There was only one institution connected to the Internet. For a time two NRENs were developing, but eventually they merged. There were very positive provisions from the government, including free provision of domestic channels. By 2005, there was a well-developed national network (AzRENA) with 30 institutions connected.

Georgia

In 2002 GRENA had one institution connected in the Tblisi area. By 2005, this had spread to Points of Presence (PoPs) in its four principal cities and 250 institutions were connected. It was very difficult to attract Georgian government funding for GRENA itself, though they were able to obtain considerable additional funding through contracts. One such contract was to provide Internet access to schools. They were among the first to move to international fibre connectivity.

Kazakhstan

The link between SILK-1 and the prior DESY project was poor here as the 20 Km distance between the site of the High Energy Institute and the main institutions in Almaty created a problem. KazRENA was not yet operational in 2002. No institutions were connected. There were plans for connecting 38 other institutions in the Almaty area. By 2005, KazRENA was well established, connecting in 25 institutions in the Almaty area. The sheer size of the country, the cost of domestic channels and regulatory constraints made it

very difficult to change KazRENA into a country-wide NREN. There was no real government support by 2005 for the NREN.

Kyrgyzstan

The Kyrgyz NREN KRENA had a unique organization, which gave it simultaneously great advantages and disadvantages over all the other countries. There was a commercial ISP, AKNET, which operated the KRENA network on behalf of KRENA. This gave it the advantage that even in 2002, there was a 1.5 Mbps link in operation. On the other hand, the monopoly telecommunications provider Kyrgyz Telecom was worried that KRENA might provide commercial competition. The differences between AKNET and KRENA were somewhat opaque. Even in 2002, there were 10 Bishkek institutions attached to SILK – more than in any other country. In the early stages of SILK-1, there was no permission to use the East→West transmitter channel of the SILK node, and they had to use a satellite channel via Moscow run by AKNET. This suspicion was still there in 2005. While they had good services for 4l Bishkek institutions, they had still failed to obtain a communications channel to Osh, the principal city in the South of the country. They were completely ready to move to international fibre as soon as it became available – and this indeed eased its regulatory problems.

Tajikistan

In 2002, no Dushanbe institutions were connected to TARENA, the Tajik NREN. The domestic network connections had been financed by OSI. Over the next three years 12 institutions in Dushanbe were connected, and some nearby. There was no progress on extending TARENA to other parts of the country – mainly because of the terrain and the high cost of satellite connections.

Turkmenistan

In 2002 the academic community was still not connected to the Internet. TURENA was however part of the Silk project from the beginning and was one of the first NRENs that were connected. With government funding by 2005 TURENA has been able to create a national network connecting 25 institutions of science and higher education in Turkmenistan. The political situation in Turkmenistan at that time stood in the way of establishing a real organisation comparable to European standards.

Uzbekistan

Uzbekistan was the best-developed NREN from the beginning of SILK. Even in 2002, there were already 40 institutions connected. The network was financed by UNDP and OSI. By 2005, it had a complete national infrastructure, with all 250 institutions of Higher Education connected. Although fully financed by UNDP, it was still a quasi-government organization. It was clearly the nearest to a Western NREN in the Central Asian region.

6. SILK-2

The initial SILK-1 project was for three years of operation finishing at the end of 2005. Usually there are problems in getting this sort of project extended. However, as a result of the September 2011 event in New York, and the subsequent wars in Iraq and Afghanistan, these two regions became of immense strategic importance. When the time for renewal came, it transpired that SILK was the only project being funded by the Science for Peace programme that had a regional extent. Thus there was no problem in getting funding for a further three years at a slightly increased rate. For bureaucratic reasons, there were considerable delays in the issue and evaluation of the follow-on tender. Though this time there was some fibre availability, none of the serious offers were for anything but satellite capacity. In the end another VSAT network, still based on a hub In DESY, was contracted from VIZADA. The contract called for 30 Mbps (24 Mbps W→E and 6 Mbps E→W)[3]. Again

the EC agreed to finance the project management, and this time also to support meetings and a little training. Cisco and University of Groningen donated some 200 telephones and cameras. Thus a much more professional and complete project could be mounted.

While the VIZADA contract was for satellite capacity, by 2006 fibre capacity started becoming available in the Caucasus and a little later in Central Asia. VIZADA was persuaded to allow the substitution of fibre capacity for satellite where this was feasible. Fibre capacity was provided in GE and AZ during 2007/2008, and in KG, KZ and UZ during 2009.

By 2008, it was clear that the importance of Afghanistan to NATO was increasing, so as we put in fibre capacity under SILK-2 into other regions, the earth stations released were moved to Afghanistan. By 2010, these had been installed in four cities of AF – Kabul, Herat, Kandahar and Mazur-al-Sharif. These sites actually had a better signal from the satellite than the other SILK stations in Central Asia. However, while the SILK nodes outside AF connected in a whole NREN, those in AF connected in only one university. There was no NREN there, and no Acceptable Use OPolicy (AUP).

7. The Caucasus after SILK

By 2009, the European Commission had decided to support connection of the Caucasus NRENs into the European GEANT by its own Black Sea Interconnect (BSI) project [4]. This provided a more serious 34 Mbps bandwidth per country via fibre. The NATO programme funded some equipment to aid the transition. The BSI project required the countries to contribute 20% of the total costs in the first phase of the project. This contribution was increased to 50% at the second stage.

8. CAREN

In 2009, the EC decided to set up a similar project called CAREN [5] for Central Asia. It again provided for 34 Mbps per country. For various reasons, mainly political, only KG, TJ, TM joined CAREN initially. Again there was initially a need for the countries to pay 20% of the cost; it was not mandated that each have the same bandwidth. In 2012 KZ also started to use CAREN for their international connectivity and now has a 155 Mbps link to GEANT, as has KRENA, the Kyrgyz NREN.

9. Non-NREN Connectivity

Although the outside funding described so far has been for connecting NRENs into the Internet, some countries have not followed this model exclusively. The NRENs often have to compete with commercial ISPs in providing advanced services for their academic users. Private universities in KG have direct connections to the Internet via local ISPs. In KZ, there is a major initiative to establish a new university in Astana. This university has now joined the Kazakh NREN KaZRENA, but retainsits own 100 Mbps link directly to GEANT.

10. SILK-Afghanistan

We mentioned in Section 6 that four nodes of SILK-2 were set up in Afghan cities towards the end of SILK-2. In 2009, the relevant division of NATO, now called *the NATO Public Diplomacy Division* (NATO-PDD) decided to set up a similar project modeled on SILK-2 but called SILK-Aghanistan [6]. While a project like SILK-1 and SILK-2 could be run from a university environment like UCL-DESY-UoG, this could not be done in Afghanistan. The political and security situation there makes that quite infeasible. For this reason, two parallel initiatives were started under NATO-PDD auspices, though with UCL and DESY acting as NATO-PDD consultants. One project, initially considered as a purely satellite one, provides communications back to a VSAT hub run by VIZADA in Bratislava. The other,

funded by the US Department of State (US-DoS), funds a fibre links via the Afghan Carrier AFTEL. The first connects in nine universities, the latter about another ten. In addition there are other grants to provide infrastructures inside each constituent university. The satellite contract was initially for 57 Mbps (43Mbps W→E and 14 Mbps E→W). This was scheduled to be increased by 30 Mbps in 2012, with the VIZADA contract providing the extension option. In the event, this extension is now being provided by 30 Mbps W→E and 15 Mbps E→W fibre from AFTEL to Kabul U. US-DoS support is mainly for fibre via AFTEL, and provides typically 1-3 Mbps links to the smaller universities, rising to some 8 Mbps to the large ones. In some cases, there is no fibre access available in the cities, and the US-DoS provision still has to be done by satellite. A further 25/12.5 Mbps is currently being provided from that source.

A further project is now in the planning stage in which most of the national links will be aggregated, and a small number of fibre links will be introduced. The implementation of this network will start towards the end of 2012, and is intended to be largely complete by the time SILK-Afghanistan ends in mid-2013.

11. IPv6 Activities in the Region

Already in SILK-1, with assistance from another EC project (6NET), we were able to do some IPv6 experiments between four sites [7]. However these experiments were run almost entirely from the Western side, and merely showed that the equipment in use did not make efficient use of the network. Under the aegis of the *EC 6DEPLOY* project [8], there was an IPv6 training workshops in Ashgabat in 2007; though attended by some 20 students, it did not lead to any deployments. Under the same aegis, but with additional donations from Cisco, small IPv6 laboratories were set up Tbilisi (2009), Bishkek (2010) and Almaty (2011). The Bishkek workshop led to an institute there becoming the official IPv6 support centre for CAREN, and that network is now dual-stack IPv4 and IPv6. The Almaty workshop has led to KazRENA providing training courses to Kazakh Telecom, though I an not aware of any real IPv6 deployments there yet.

Nevertheless, I find it encouraging that some of the countries, for instance Kazakhstan and Afghanistan, have announced official policies for moving towards IPv6 which have not yet been stated by many of the more advanced countries in Europe. While this is clearly due to the vastly larger IPv4 address space available in Western Europe, and the extent of their Internet deployment, it is still a credit to the awareness of the governments of these regions of the problems they will face in the future. To my knowledge, the countries have not yet thought through the training needs that their policies will imply; I hope that this will follow shortly.

12. Conclusions

It is clearly not possible to draw many conclusions that apply uniformly across the total geographic area covered in this paper. The area and population vary hugely. Armenia has a population of 3M and an area of 30 Sq Km; the corresponding figures for Afghanistan are 35M and 650 Sq Km, and for Kazakhstan 16M and 2.7M Sq Km. There is similar variation both in political system and GDP. Nevertheless, all the countries, except Afghanistan, have achieved in the first 10 years of this century what the Europeans achieved, in 20 years with western help what the advanced economies achieved in 20year. All are now part of the Internet community. Afghanistan has not reached the same level yet – but then it started less than five years ago with a very difficult social and security environment. We must hope that the local conditions will allow them to achieve similar levels before the outside aid bodies withdraw their support.

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