SEVENTH FRAMEWORK PROGRAMME
Research Infrastructure

FP7-INFRASTRUCTURES-2010-2 – INFRA-2010-1.2.3:
Virtual Research Communities

Combination of Collaborative Project and Coordination and Support Actions (CP-CSA)

LinkSCEEM-2
Linking Scientific Computing in Europe and the Eastern Mediterranean – Phase 2

Grant Agreement Number: RI-261600

D 7.1

Report on services and bandwidth requirements

Final

Version: 1.0
Author(s): Yousef Torman,JUNet
Date: 26/01/2011

Project and Deliverable Information Sheet

LinkSCEEM Project	**Project Ref. №: RI-261600**	
	Project Title: LinkSCEEM-2	
	Project Web Site: http://www.linksceem.eu	
	Deliverable ID: D 7.1	
	Deliverable Nature: Report	
	Deliverable Level: PP	**Contractual Date of Delivery:** 30 / November / 2010
		Actual Date of Delivery: 31 / January / 2011
	EC Project Officer: Leonardo Flores Anover	

* - The dissemination level are indicated as follows: **PU** – Public, **PP** – Restricted to other participants (including the Commission Services), **RE** – Restricted to a group specified by the consortium (including the Commission Services). **CO** – Confidential, only for members of the consortium (including the Commission Services).

Document Control Sheet

Document	**Title: Report on services and bandwidth requirements**	
	ID: D 7.1	
	Version: 1.0	**Status:** Draft
	Available at: http://www.eniac.cyi.ac	
	Software Tool: Microsoft Word 2007	
	File(s): LinkSCEEM-2-Deliverable-7.1.doc	
Authorship	**Written by:**	Yousef Torman, JUNet
	Contributors:	Marina Andreou, CYNET, Despina Saparilla, CaSToRC
	Reviewed by:	Hank Nussbacher, IUCC
	Approved by:	PMO

Document Status Sheet

Version	Date	Status	Comments
0.1	31/January/ 2011	Draft	
0.2	DD/Month/YYYY		
1.0	14/February/2011	Final version	

Document Keywords

Keywords:	LinkSCEEM-2, Computational Science, HPC, e-Infrastructure, Eastern Mediterranean

Table of Contents

References and Applicable Documents

[1] http://www.linksceem.eu
[2] http://www.prace-project.eu
[3] http://www.srf.gov.jo/priority.html, research priorities of Jordan
[4] Computing Needs of SESAME Visit Report to Research Centers in Europe, LinkSCEEM D3 Annex 2, December 20, 2009

Executive Summary

This document describes the findings of the study into the services and bandwidth requirements of the HPC community in the Eastern Mediterranean region. The approach adopted was collection of information on the research interest in Jordan and neighbouring countries in the coming years, as well as the potential research areas and applications in the coming 5 years. We reviewed the Jordanian national research priorities, SESAME potential research and science areas and also interviewed some researchers and Deans of research in Universities in Jordan. The visits to the Universities included University of Jordan, Yarmouk University, Jordan University of Science and Technology, Mutah University, Al Al Bayt University, Al Hussein University, Hashemite University, Princess Sumayya University, Royal Scientific Society and Balqa Applied University.

1 Introduction

This document is prepared in response to Deliverable D7.1, within the scope of the network connectivity work package, WP7, of the LinkSCEEM-2 project. The aim of the work undertaken by this task is to identify the bandwidth and services needed to meet the requirements of the HPC community in the Eastern Mediterranean region, including the needs of the research community at SESAME. The latter will directly benefit from the communication link LinkSCEEM-2 WP7 aims to establish between the Jordanian Universities Network (JUNet) and the Cyprus Research and Educational Network (CYNET) by gaining direct access to HPC resources located at the Computation based Science and Technology Research Center (CaSToRC), the National Authority for Remote Sensing and Space Sciences (NARSSS) and at Bibliotheca Alexandrina (BA)

For the collection of the information needed for the identification of applications and their bandwidth needs, several approaches were considered including sending out questionnaires to the research community, face to face interviews with Professors and researchers of Eastern Mediterranean Institutions, as well as identification of applications currently used in the region and their respective bandwidth requirements.

The approach finally adopted in this task was based on gathering and combining input from various sources through conducting one-to-one interviews with scientists and researchers in the Eastern Mediterranean area. Interviews were thought to be more efficient than questionnaires in collecting the exact information needed. In addition to the interviews that took place, a separate study focused on the Jordanian National Research Priorities as well as on potential research/science areas at SESAME, which is constructing a major international research center in the Middle East as a cooperative venture by the scientists and governments of the region.

2 Scientific Research Areas and Associated Applications

Based on our approach of identifying the scientific research areas and associated applications with demand for bandwidth in the Eastern Mediterranean region, we have considered the following scientific user communities and research priorities.

2.1 SESAME Scientists

Scientists at the SESAME facility in Jordan have research interests in a diverse set of areas, ranging from Medical Science and Imaging to Particle Physics. The following are the most common scientific areas amongst the SESEAME user community:

a. Tomography, XRD and Medical image processing
b. Atomic Molecular Structures Sciences
c. Electronic structures and Bonding
d. Magnetic Structure and Properties
e. Applications for researchers who work on gathering data (Crystallographers)
f. Structural Molecular Biology
g. Surface and Interface Science
h. Environmental Science
i. Material Science
j. Archaeological Science

The applications in the above research areas of the scientists at SESAME require moderate amounts of storage and computing power. Crystallographers, researchers who work on gathering data, require significant data storage capacity and computational resources. The most demanding applications with respect to HPC resources have been proved to be the applications used in tomography, XRT and medical image processing, as they produce high volumes of data and require real time supercomputing resources.

Local HPC resources are needed at SESAME for meeting such real time requirements, while beam line data could be stored and processed on remote HPC resources located at CaSToRC. A large amount of experimental data from the beamline detectors will need to be efficiently transferred to Cyprus, requiring a high-speed network connection. As reported in the study performed under the original LinkSCEEM project on the assessment of the computing needs of SESAME [4], for the SESAME computing model to work, where HPC facilities are remotely based at the Cyprus Institute, a high throughput network connection between SESAME and CyI ranging from 155 Mbps to 1 Gbps is necessary to transfer the experimental data efficiently.

2.2 Jordanian Researchers

Scientists and Researchers at Jordanian Universities have identified the following research areas as the areas they actively participate in and require high computational performance that vary according to the applications and the volume of data that are processed.

a. Medical Physics
b. Biological sciences
c. Material Sciences
d. Archaeology
e. Hydrology
f. Particle Physics
g. Robotics
h. Computational Chemistry
i. Earth Sciences
j. Geophysics
k. High Energy Physics
l. Multimedia
m. Material Sciences
n. Biomedical informatics
o. Climate change, environment, earthquakes
p. Neurology

2.3 The Research Priorities of Jordan

A study was performed with focus on Jordan's National Research Priorities that lead to the identification of the main scientific areas and research topics. This information was filtered further and summarized, with some areas being eliminated due to their minimal requirements in terms of bandwidth intensive applications concluding to the following short list of scientific areas:

a. Antiquities & Tourism: (Documenting of Structures and Archaeological and Heritage Sites; Conservation and Restoration of Archaeological Sites and Monuments)
b. Information & Communication Technology: (Information Security and protection, protection and Computer Crimes, Information Technology in

Health, Energy, Environment and Agriculture, Electronic Content and Education and Knowledge-Based Society)

c. Culture, Arts and Media: (Data Banks and Centers of Culture, Arts and Media, The Role of Culture, Arts and Media in Maintaining the History, Heritage and Arabic Identity of Jordan, The Role of Culture, Arts and Media in Approximating Arab Societies and Different Civilizations(Understanding the Other), and Expertise Exchanges Amongst Them)
d. Social Sciences, Humanities & Language: (Sociology, History, Geography, Arabic and English Languages)
e. Basic Sciences: (Materials' Science; Nano -Technology; Environment and Health; Biology Sciences; Bio-Technology, Energy, Earth Sciences, Mathematics and Statistics)
f. Agricultural and Veterinary Sciences: (Sustainable Management of Natural Resources, Improvement of Sustainable Productivity of Irrigated Agriculture, Improvement of Sustainable Productivity of Animal Production, Technological Innovations in Agriculture, Food and Nutrition, Biodiversity, Supporting Environment for Agriculture)
g. Medical & Pharmaceutical Sciences: (Primary Health Care, Integration of Mental Health Services, Regenerative Medicine and Stem Cell Research, Benign Haematology, Diabetes Mellitus, Cancer, Molecular Epidemiology of Diseases, Respiratory Tract Infections, Utilization of Jordanian Medicinal Plants)
h. Water & Environment Sciences: (Integrated Approach to Water Resource Management; Groundwater Recharge, Innovation in Irrigation Water Management, Integrated Waste Management, Databases and Information Systems for Water Resources and Environment, Air Pollution and Control, Impacts of Climate Change on Water and Environment)
i. Engineering Sciences: (Development and Utilization of Renewable Solar and Wind Energy Systems, Water Desalination, Mining of Oil Shale, Exploration and Mining of Uranium, Management of Energy and Environment, Industrial Materials and Products, Communication Infrastructure, Automation and Automatic Control)

2.4 Research in the Region

Focusing on the countries in the region around Jordan, namely Syria and Palestine, we concluded that researchers in these countries have very similar priorities and research interests as researchers in Jordan. Both countries are engaged in regional collaborative research projects and have experience and interest in continuing and strengthening regional collaboration.

Both Syria and Palestine are partners of the EUMEDCONNECT-2 Network and the EUMEDGRID Support Project and in addition they participate with Jordan and other countries in the region in the Arab States Research and Education Network (ASREN), the association of the Arab region National Research and Education Networks (NRENs) and strategic partners. ASREN aims to implement, manage and extend sustainable pan-Arab e-Infrastructures dedicated for the research and education communities and to boost scientific research and cooperation in member countries through the provision of world-class e-Infrastructures and e-services.

2.5 Other services and applications

A variety of services and applications within the field of education were also identified by getting input from other countries in the region such as Cyprus. Some of the applications are used to aid and support research, such us for example grid middleware and e-Infrastructure services. Additionally, e-libraries and e-learning applications rely on the underlying network and have high bandwidth requirements. Below is a list of such applications/services:

a. Virtual classroom services between European Universities and Institutions supporting high definition (HD) video. Bandwidth need: Gigabit connection.

b. e-learning services which incorporates the need for exchange of contents, graphics, audio and video over the network. Bandwidth need: Gigabit connection.

c. e-libraries and associated services

d. e-Infrastructure services that require middleware such as grid computing infrastructure

e. Access to research resources and instruments around the region.

f. European Research Projects in the sectors of Informatics, Medicine, Physics, Chemistry and Biology, where partners from Eastern Mediterranean region participate in, require high bandwidth (Gigabit) connections due to the high volume of data they are dealing with. In such projects a database is developed at the site of one partner and the other partners are required to have access to this database via high speed connections.

3 Bandwidth Requirements

Currently bandwidth requirements in Jordan emanate from applications using the EUMEDGRID Support infrastructure and from collaborative projects under the framework of EUMDIS, EUMEDCONNECT and TEMPUS. **Figure 1** shows the bandwidth utilization in 2010 on the 45 Mbps EUMEDCONNECT link connecting Jordan (JUNet) to the GEANT network (UK PoP). The figure shows that the link is occasionally used at full capacity for significant durations.

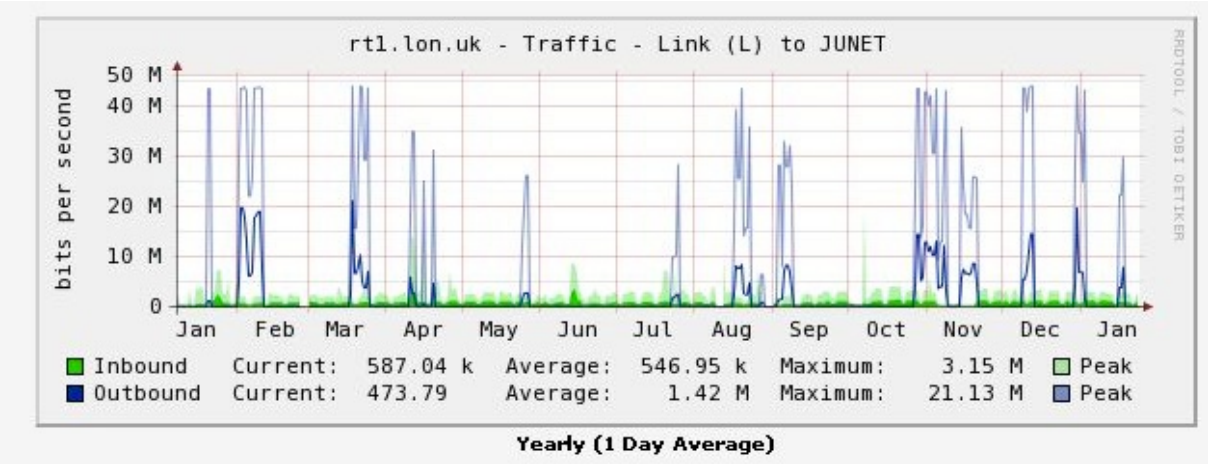

Figure 1 2010 bandwidth to JUNET (from Dante's EUMEDCONNECT monitoring)

The applications and services currently used in the scientific and research community have high bandwidth needs and the trend and projections of the coming years will be more bandwidth thirsty applications. The establishment and support of scientific research communities with HPC needs within the framework of the LinkSCEEM-2 project, and the integration of the HPC facilities in Cyprus and Egypt, are expected to give rise to further connectivity requirements in the region. The ramp up of SESAME activities, which is expected to produce its first data sets in 2013, will further increase the demand for bandwidth between Jordan and Cyprus.

Rami Ahmad, previously at SESAME, conducted an extensive study into the computing needs of SESAME in 2009, which was included in the LinkSCEEM final report on the “Assessment of needs” (WP2). Rami Ahmad reported that it is expected to have a large amount of generated experimental data from the SESAME beamline detectors, estimated to be of the order of a few TB per day, based on the current cutting-edge detectors technologies. This number is only going to increase in the future as a result on evolving technologies in beamline detectors. A high throughput network connection between SESAME and CaSToRC is thus a requirement and crucial for the analysis and simulation of the SESAME data, and the support of the general collaboration between the two institutions.

In general, bandwidth requirements depend on the following factors:

- Type of application, i.e. some applications are compute intensive and require computing power with moderate data transfer, on the other hands some applications and services require high speed networks such as image processing and e-learning
- Volume of data to be transferred, for example, some experiments of the SESAME generate a very large amount of data that needs to be transferred for further processing and analysis.
- Frequency of using the application. If the application is used very frequently then it will obviously require more bandwidth.
- Number of researchers using the application and their distribution around the region.
- Quality of service: some applications and services require high level quality of service which in this case requires a dedicated bandwidth to be allocated for this service all the time.

The following are the main driving factors behind the bandwidth requirements defining the regional interconnectivity needs in the Eastern Mediterranean region:

1) SESAME's operation and the transfer of large amounts of data from SESAME to remote HPC facilites (CaSToRC)
2) Jordan's Government is now supporting research activities through the National Research Fund, which will encourage more researchers to be engaged in research
3) Projects such as LinkSCEEM-2 and EUMEDGRID Support, which create exceptional opportunities for the establishment of virtual and collaborative research communities that require, distributed computational resources.

Finally, considering countries in the region, Syria and Palestine engage in research activities, with some initiatives taking place at the national level. Both countries are involved in EU collaborative research and education projects. This indicates that they also have the culture of conducting common and joint research projects across the region.

4 Conclusion

The work undertaken during this study focused on gathering information on scientific research fields within the Jordanian research community, as well as at the SESAME facility. It was found that active collaborative research exists that requires regional interconnectivity. Based on JUNet experience with the utilization of the EUMEDCONNECT2 link and the findings of this study, we conclude that the upgraded link interconnecting SESAME and CaSToRC will be highly used. Demand for bandwidth will increase significantly once SESAME activities have ramped up, and based on the study of the SESAME computational needs, the 155 Mbps upgraded link is expected to be fully utilized. The possibility of contracting for higher capacities than 155 Mbps should thus be explored, especially when one considers that the prices of circuits are decreasing.

The LinkSCEEM-2 initiative to establish and support research communities with HPC requirements in the Eastern Mediterranean region will contribute to the need for regional interconnectivity. The work initiated under this deliverable will be updated during the project based on new information gathered at the LinkSCEEM-2 user meetings and workshops. For example, a questionnaire (see Annex 1) will be distributed during the upcoming LinkSCEEM-2 user meeting in Jordan aimed at gathering information on service and bandwidth needs. Based on the filtered results, projections for future needs will be made and will be included in the next updated version of this deliverable.

5 Annex 1 Questionnaire on Applications and Bandwidth

Name:		
Organization:		
Scientific field (optional):		
Email:		
Country:		
Brief description of the applications/projects you are using and may require HPC resources.		
If HPC resources were available to you from Cyprus, would you make use of it?		
List any FP6 or FP7 projects you have been involved in.		
Please indicate the average bandwidth (inbound and outbound) your application/project used in 2010.	**Inbound:**	
	Outbound:	
Please indicate the peak bandwidth (inbound and outbound) your application/project required in 2010.	**Inbound:**	
	Outbound:	
Please estimate the average bandwidth (inbound and outbound) that your application/project will require in 2012.	**Inbound:**	
	Outbound:	