



Five Years Report



April 2016

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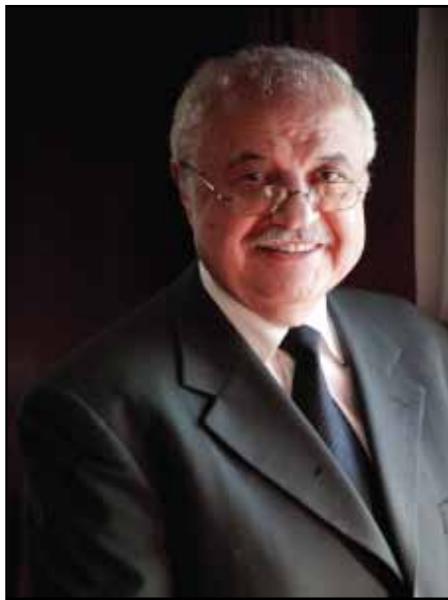
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Forward

It gives me pleasure to present the Five Years Report of ASREN as we move into an era of change towards investing to advance the pan-Arab research and education high-speed communication networks. The advancement of these networks has been realized through the funding schemes provided by the European Commission in the context of EUMEDCONNECT3 and AfricaConnect2 projects as well as other complimentary projects and services such as EUMEDGrid, CHAIN and CHAIN-REDS, MAGIC, and OPEN. The networks and services provide powerful means for team collaboration, sharing of resources, and exchange of real-time simulation and data transfer at the national, regional and global levels.

With the support of the European Commission and Talal Abu-Ghazaleh Organization, ASREN has been developing means to connect all Arab research and education institutions in a unified network that provides scientists, academics, students, and researchers with state-of-the-art connectivity. An open exchange point is now established in London to peer with research and education networks at the global level and will be linked to regional open exchange points to emerge in Fujairah - United Arab Emirates and Al Maadi - Egypt.

ASREN will continue to join efforts with its European counterparts to bring new technology means and services to the Arab research and education communities and to provide enhanced educational environments equipped with better tools, connectivity, and services.

Dr. Talal Abu-Ghazaleh
Chairman of ASREN

1	Introduction	7
2	Research and education network	7
	2.1 Connectivity network	7
	2.2 Benefits and drivers	8
	2.3 Regional connection	8
3	ASREN	9
	3.1 Historical perspective	9
	3.2 Vison and mission	10
	3.3 Objectives	10
	3.4 Functions and services	11
	3.5 Organization	12
4	Arabia research and education network	12
	4.1 Algeria research network - ARN	13
	4.2 Egyptian universities network - EUN	13
	4.3 Jordanian universities network - JUNet	13
	4.4 Lebanon national research network - LNREN	13
	4.5 Morocco academic and research network - MARWAN	14
	4.6 Oman research and education network - OMREN	14
	4.7 Palestinian national research and education network - PaLNREN	14
	4.8 Qatar national research and education network - QNREN	14
	4.9 Saudi academic research and innovation network	14
	4.10 Somali research and education network - SomaliREN	14
	4.11 Sudanese research and education network - SudREN	15
	4.12 Syrian higher education and research network - SHERN	15
	4.13 Tunisia national university network (RNU)	15
	4.14 United Arab Emirates advanced network for research and education - Ankabut	15
	4.15 Remaining Arab countries: Bahrain, Comoros, Djibouti, Iraq, Kuwait, Libya, Mauritania, and Yemen	15
5	Network development	16
	5.1 International connectivity	16
	5.2 Connectivity hubs	17
6	The EU cooperation projects	18
	6.1 Africa Connect	18
	6.2 EUMEDCONNECT Network	19
	6.3 The EUMEDGRID infrastructure	19
	6.4 The Africa & Arabia Regional Operation Centre	20
	6.5 CHAIN and CHAIN - REDS	20
	6.6 MAGIC	20
	6.7 OPEN	20

7	Events	
7.1	e-AGE 2016	21
7.2	e-AGE 2015	21
7.3	e-AGE 2014	22
7.4	e-AGE 2013	22
7.5	e-AGE 2012	23
7.6	e-AGE 2011	23
7.7	ASREN Launch 2010	23
7.8	Workshops	24
8	Planing	
9	Conclusion	

EXECUTIVE SUMMARY

This report presents ASREN's development during the past five years of its inception in 2011 as a non-profit organization of Arab NREN shareholders with a large contribution of Talal Abu-Ghazaleh Organization. The creation of educational and research connectivity infrastructure across the Arab region has enabled institutions to join the globalizing research and education networks. The networks interconnect NRENs across the Arab region through a high-speed network via the Arabia Global Exchange (AGE) Points, now established in London and will soon be setup in Fujairah. The exchange points provide physical fiber cross connects, circuit switching, packet based VPN services, with open access to all R/NRENs, carriers, and content providers.

ASREN has contributed to the creation of unified connectivity to all research and education communities with standard communication facilities and capabilities, leading to better sharing of resources, information, data, knowledge and expertise. This will enable Arab universities and research centers to interconnect with seamless and federated access to tremendous globally available research and education resources and databases, digital repositories, computing infrastructures, and applications. It has also contributed to setup Science Gateway with community-development tools, applications, and data, integrated via a customized portal with access federation capability as well as the setup of eduroam (education roaming) service as a world-wide roaming access service developed to support the mobility of researchers to access their research and data while being away from their labs and offices.

The European Commission (EC) has largely contributed to the development of research and education networks at the national level (NRENs) and the regional level (ASREN) and the international connectivity. The EC cooperation projects provided means of support to the Arab Mediterranean countries in Grid Computing and e-Infrastructure services. The objective is to foster information society and to develop high-speed connectivity to higher education institutions and research centers. The EUMEDCONNECT, EUMEDGRID, and AfricaConnect series of projects have been recognized as important cooperation projects that are co-funded by the European Commission. In EUMEDCONNECT and AfricaConnect2, ASREN has coordinated closely with GÉANT to contract international links to partner countries in the Arab Mediterranean region as well as to establish peering via its PoP in London with the European GÉANT and the global research and education networks. The interconnected global networks will allow students, researchers, and academics to collaborate with their peers from around the world. The connectivity boost not only advances research and education in the Arab region with opportunities like high performance computing, e-learning, and cloud computing, but also benefits global scientific cooperation in areas such as climate change, biodiversity, food security, energy, and infectious diseases.

Furthermore, the EUMEDGrid project has largely contributed to the development of e-Science and Grid-based e-Infrastructure with more than 36 sites in 11 countries for a total of 4,000 CPU cores and 600 Terabytes of storage capacity, jointly operated and managed through the Africa-Arabia regional operation center. This has provided support to many scientific domains in physics, fluid dynamics, and bioinformatics with support of parallel computing using OpenMP and MPICH2 protocols. As a result, consolidated best practices and standards have been developed for enabling transparent e-Infrastructure provisioning across regions in support of the European Grid Initiative.

ASREN has contributed to the development of interoperable e-Infrastructure platform with peers in Europe, Latin America, India, China, and Africa through the CHAIN and CHAIN-REDs projects. This has contributed to the setup of ASREN science gateway and eduroam activities to support technological and scientific collaboration in various continents towards the realization of a global e-Infrastructure ecosystem. Research communities are now able to access and efficiently use worldwide-distributed resources (e.g. repositories, storage, clouds, HPC, services, tools, and applications). With MAGIC project, ASREN seeks to establish a set of agreements for Europe, Latin America, Africa, India, and China that aim to consolidate and complete middleware building blocks for real-time inter-continental research applications and services.

The middleware building blocks are built around technologies of eduroam and federated identities and access. OPEN project is another dimension where ASREN has contributed to its communities and members. OPEN is meant to create an opportunity platform for transformative higher education and innovative research network in Morocco. Its purpose is to transform teaching and learning through open source technologies and create research network towards a comprehensive backbone of Arab-German community of practice.

ASREN has organized an annual regional and international platform to create awareness and dialogue and to bring together innovators, leaders, scientists, and businesses on how best to integrate Arab e-Infrastructure in a Global Environment (eAGE). With over 200 delegates from around 40 countries each year, e-AGE has been held in Jordan in 2011 under the patronage of His Majesty King Abdullah II; United Arab Emirates in 2012 under the patronage of His Excellency Nahyan Mubarak Al Nahyan; Tunis in 2013 under the patronage of His Excellency Moncef Ben Salem; Oman in 2014 under the patronage of His Highness Sayyid Taimur bin As'ad Al Said; Morocco in 2015 under the patronage of His Majesty King Mohammed VI. In 2016, e-AGE will be held at the American University of Beirut in Lebanon with a theme "Ubiquity and Cohesiveness of e-Infrastructures". ASREN has also conducted several workshops for capacity building and NREN development in Amman, Beirut, Rome, Baghdad, Tripoli, Sanaa, Manamah, Kuwait, Tunis, and Rabat. Topics include network management, identity federation, clouds for research, e-Science, and more.

The pace of development in the five-year time frame has largely contributed to the success of ASREN in supporting research communities across the Arab region. Its five-years plan is to create a sustainable "Arab Connect" high-speed network compatible to GÉANT and Internet2, with larger scale of network and science services in research and education domains. In short term, the plan of ASREN focuses on including of new shareholders; supporting the development of Arab NRENs; connecting more NRENs to the ASREN/ AC2/EUMEDCONNECT3 network; maintaining ASREN PoP in London and developing new PoPs; building ASREN physical network; providing network services; organizing workshops to support building capacity in new technologies; and focusing on dissemination and sustainability.

1. INTRODUCTION

Education and scientific research have become key elements and significant resources for economic development, technological innovation, and knowledge creation in the Arab region. The practice of scientific research is changing dramatically. Researchers working in isolation no longer contribute to technological innovations or social development. Only through multidisciplinary collaborations among research centres, industry and public entities that knowledge, innovation, and know-how can be facilitated. ICT technologies have played a major role in making such collaboration possible. The creation of an educational and research connectivity infrastructure has an amazing potential, most dramatically in its impact on enabling institution to “boot up” and join the globalizing developed world.

It has been noted that cooperation among Arab countries has been weak in scientific research. Renaissance is critically needed to meet regional challenges in areas related to education, health, environment, security, and governance. Today's research imposes new requirements not only in the way it is being conducted, but also in the computational aspects. Therefore, it has become essential to build up special dedicated network to connect research and education institutions with the purpose to:

- Widen the connectivity of National Research and Educational Networks (NRENs) into a Regional Research Networks.
- provide education/ research institutions with reliable means of communication at the regional level
- Strengthen the notion of partnership and encourage joint scientific research at all levels.
- Minimize the cost by using available research, academic and technical resources through a dedicated network with no need for duplicating investment.
- uplift efficiency and productivity and boost the concept of creativity and innovation through the use of e-infrastructure and network available resources.

Therefore it has become a necessity to establish a regional network connecting existing NRENs in the Arab countries. Such a regional network still needs to be dedicated to research and education among academic institutions, research centers, and public/ private entities, respond to their demand for dedicated connectivity and centred on a necessity to:

- Establish scientific research networks at the national level NRENs in each country.
- Establish a network at the regional level linking all NRENs.
- Connect the regional network to the global scientific research networks.

2. RESEARCH AND EDUCATION NETWORK

Research and education networks are established as high-speed communication networks that connect solely educational institutions and research centers world-wide together and to research and educational resources, repositories, instruments, sensors etc...

2.1 Connectivity network

In general, NREN comprises dedicated high speed networks that act at the national level to provide connectivity between universities, research institutes, educational hospitals, schools, further education colleges, libraries and other public institutes. These networks can be built using dedicated fibre optic connections or utilizing less flexible and high cost leased capacity from telecommunications providers.

There are two key drivers for R&E networking: one is related to the network and the other is related to the type of applications. The network drivers are: increased bandwidth requirements on the backbone for some scientific and real-time applications; growing interest in IPv6 protocols; and networking security necessary in some critical applications. The drivers from the applications perspective are generally motivated by the requirements of real-time networking and need for reduced interaction time between distributed users and processes. With dedicated R&E networking, features like low network latency; consistent temporal delivery of data; low network jitter; economies of scale in journal subscriptions and software licensing, sharing of resources, and distributed interaction / visualization of large data sets can be guaranteed.

2.2 Benefits and drivers

In the context of research and education networking, NRENs allow researchers, faculty, staff, and students around the country to communicate with each other and to access a broad range of research tools and information resources. NRENs also provide applications and services, including videoconferencing, media streaming, collaboration tools and services, access federations, and wireless roaming. In some cases, NRENs establish and coordinate distributed computing resources (Grids, HPCs and Clouds) and operating experimental test-beds for data-intensive applications. Furthermore, some NRENs operate national domain registries for the entire Internet community in their countries, and in some cases, provide security services for their own community, government, military as well as commercial sectors.

The main drivers for creating NRENs are based on technological, social, and economic factors, and are identified as follows:

- Technological: To satisfy high demand e-Science initiatives, including Multimedia Collaboration, Distributed High Performance Computing (HPC, GRIDs), Earth Sciences, High Energy Physics (CERN, LHC...), Bioinformatics, Computational Chemistry, Radio-astronomy (eVLBI), Engineering (computations, emulations & simulations), Cultural (archiving, collaborative digital access & processing).
- Social: To meet societal needs towards: common culture of R&E community, virtual organizations, collaborative research, distant education, and smoothing the digital divides at the country level and beyond by linkage to the Global R&E community.
- Economic: To develop capacity for economic prosperity: demand aggregators of university staff, students, and researchers, consolidation and control of diverse public expenditures, promotion of information society (e-Government, e-Business, e-Health, etc.), and Stimulation of technological developments & telecom markets.
- Globalization: Research and Education Networks are moving to global RENs to cope with the demand resulting from team sciences and big data globally.

2.3 Regional connection

NRENs are usually interconnected with other research and education networks, as well as to the wider Internet. Regional networks exist to interconnect NRENs in certain regions, and to other parts of the world. The European GEANT, US Internet2, Canadian CANARIE, and Latin American CLARA are examples of regional networks. In the Arab region, the regional network is ASREN, which builds on the previous EUMEDCONNECT projects since 2004 and later the AfricaConnect2 Project. ASREN will continue to serve the Arab Mediterranean countries and extend to include the remaining Arab countries.

The regional network provides high capacity and high quality connectivity for use by the research and education communities connected to the NRENs in the beneficiary partners, and connected to the European user communities via links to GEANT, which represents the Pan-European Research and Education network. For most of the beneficiary countries the EUMEDCONNECT network is the only international connectivity designed for research and education networking.

Due to the continued slow pace of regulatory reform and the related slow emergence of competitive telecommunications markets in most of the Arab countries, the national connections generally still rely on the national incumbent operators. Until recently there had been little investment in new cables in the Mediterranean region. Now, several new Europe/Asia cables are coming on stream and are running through the Mediterranean Sea. There remain hardly any cable connections directly between southern Mediterranean countries, which is why the current EUMEDCONNECT2 network consists of bilateral links between beneficiary countries and European destinations, which are then linked via the GEANT network.

3. ASREN

ASREN is the association of the Arab region National Research and Education Networks (NRENs) and strategic partners. It aims to implement and operate a Pan-Arab dedicated research and education network that connects national and regional research and education networks, worldwide. The purpose is to boost scientific research and cooperation in member countries through the provision of world-class e-Infrastructures and e-services. The e-Infrastructures enable sharing of resources and access to variety of services and applications as to highly sophisticated and technologically advanced computing resources available elsewhere.

3.1 Historical perspective

The intention of forming the Consortium of Arab Mediterranean Research and Education Networks (CAMREN) was first declared in 2006 by the 7 Arab partners of the EUMEDCONNECT project that connect over 2 million academic users and researchers in 400 research centres and educational establishments. The partner countries, Algeria, Egypt, Jordan, Morocco, Palestine, Syria, and Tunisia, are represented by their national research and education network organisations (NRENs) and co-finance the network infrastructure and management costs, a substantial investment of around 1.5 million Euros each year.

In December 2009 the idea is refined and the proposed new regional association is now the Arab States Research and Education Network (ASREN), under the patronage of the League of Arab States and the United Nations Global Alliance for ICT and Development. The lead for this has been taken by the Jordanian NREN, JUNET, and it this replaces the CAMREN proposal and enables a wider participation throughout the Arab region (U.A.E. and Oman have joined the discussion process). Since then, with the support of EUMEDCONNECT2 funded by the European Commission and managed by DANTE (UK), four strategic planning workshop have been held in Cairo (January 2010), Brussels (March 2010), Algiers (July 2010) and Rome (November 2010) to finalize all the agreements on the organisation's mission, objectives, structure and strategic plan.

A first formal announcement of the creation of ASREN was made at the Third EU-Med Conference on e-Infrastructures across the Mediterranean (EUMED Event 3) on March 31, 2010 in Brussels, by HE Dr. Talal Abu-Ghazaleh, Chairman of the Global Alliance for ICT and Development of the United Nations Department of Economic and Social Affairs (UN-GAID) at that time. Since then, Talal Abu-Ghazaleh Organization (TAG-Org) has been providing key technical and financial support in addition to political lobbying for the creation of ASREN. TAG-Org has lead the registration process of ASREN as a non-profit organization in Germany and had made all its resources available to meet the legal and financial requirements for a legally registered ASREN in Europe and operational in the Arab region. In July 2010, His Excellency Mr. Amre Moussa, Secretary General of the League of Arab

States at that time, endorsed the creation of ASREN, and announced the formal ASREN Launching at the premises of the League of Arab States in December 2010 in Cairo, Egypt. Several regional bodies including the League of Arab States Secretariat Department in charge of Science and Research, the Arab Education, Science, Culture Organization (ALESCO) and the Arab Union of Scientific Research Councils as well as representatives of UNESCO, the World Bank, European Commission, and heads of Arab delegations joined ASREN launch. In October 2011, ASREN was officially registered as a non-profit GmbH organization in Germany.

3.2 Vison and mission

ASREN's vision is to support Pan-Arab collaborative research and education projects and activities through dedicated high-speed networks and to boost scientific research, innovation and education in the Arab countries by uplifting efficiency and productivity of research and education communities. Its mission is to implement and operate 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 e-services and federated access to repositories, computing facilities, and cloud and data resources.

3.3 Objectives

The objectives of ASREN are defined as:

- To build, maintain and consolidate regional e-Infrastructures dedicated to e-Science and education across the Arab Countries, by:

- Developing, managing and operating a regional network that Interconnect the NRENs of the Arab Countries.
- Promoting harmonization of policies and standards in relevant areas at regional level.
- Advocating at the regional level amongst decision makers and stakeholders.

-To contribute to create and sustain National Research and Education Networks (NRENS) by:

- Supporting them to implementing leading-edge technological solutions while pursuing cost-effectiveness.
- Favouring the exchange of expertise and best practices amongst the NRENs' personnel in the Region.

-To facilitate the collaboration and cooperation among the researchers and academicians in the Arab region by:

- Increasing the availability and accessibility of knowledge resources for students and researchers.
- Promoting the development of Arabic contents and their availability.
- Facilitating knowledge exchange and transfer processes across the region and with relevant partners in Europe and worldwide.
- Promoting the adoption and usage of e-Infrastructures and services among the scientific community, also through training and tutoring activities.
- Strengthening regional partnerships and encouraging joint scientific research at all levels.

3.4 Functions and services

The core functions of ASREN are related to:

- Interconnection: Interconnect the NRENs and managing technical and financial resources to manage the regional network infrastructure.
- Network management of regional network: that includes design topology, tendering and managing NRENs interconnection, monitoring traffic and providing technical support and training to member (NRENs), etc...
- Commercial and financial management of regional network, as managing contracts with network suppliers managing agreements for collecting funds from NRENs, managing contracts with funding organizations or agencies and conducting advocacy activities.
- Developing Regional guidelines as for security policy or interoperability of services and protocols for supporting applications.

There equally exists support functions to develop the use and impact of the infrastructure, promoting content and usage development through the establishment the Research Gateway (Portal) and enabling cross national networks use of research and educational resources available. The portal also includes promotional activities to promote collaboration in research and education community, encourage and support the joint projects, sensitize decision makers on the research networking usefulness, develop support groups of practice, research and education communities, and promote cross network cooperation in electronic services, applications and e-services.

ASREN has been providing variety of services to support Arab NRENs and its communities at large. These include:

1. Interconnect NRENs across the Arab region through a high-speed network via the Arabia Global Exchange (AGE) Points, now established in London and will soon be set up in Fujairah.
2. Provide peering through physical fibre cross connects, circuit switching, or packet based VPN services, with equal and open access to all R/NRENs, carriers, and content providers.
3. Provide unified access to all research and education communities with standard communication facilities and capabilities, leading to better sharing of resources, information, data, knowledge and expertise.
4. Provide interconnected Arab universities and research centres with seamless and federated access to tremendous globally available research and education resources and databases, digital repositories, and computing infrastructures.
5. Setup Science Gateway with community-development tools, applications, and data, integrated via a customized portal.
6. Setup eduroam (education roaming) service as a world-wide roaming access service developed for the international research and education community.
7. Creating awareness, capacity building and technical support.

3.5 Organization

The organizational structure of ASREN is composed of General Assembly, Honorary president, Advisory committees, and Secretariat. ASREN has a General Assembly composed of its members. The General Assembly meets regularly (mainly during eAGE events) to review and approve the long term strategic plans, secretariat choice/location, activity and financial reports, and all matters related as described in the ASREN bylaws. His Excellency the Secretary General of the Arab League has been nominated as the Honorary President of ASREN.

A technical committee is formed by NRENs to advise on technical matters and network expansion/management, and support the executive branch in its functions. A science and research committee is also formed to advise on matters and issues related to network usage and research activities. An independent ASREN secretariat office is established at the premises of Talal Abu-Ghazaleh Organization supporting independence and collaborative synergies.

4. ARABIA RESEARCH AND EDUCATION NETWORK

Efforts of National REN (NREN) development in the Arab region vary with different successes. NREN efforts are at the initial stages in Libya, Yemen, Iraq, Mauritania, Comoros, and Djibouti. In Lebanon, Kuwait, Bahrain, and Palestine the formation, funding and policy in support of NREN implementation are planned but not yet decided. The remaining Arab countries have working NRENs connecting Universities and research centres, but with different networking topologies and technologies.

Figure 1 shows the status of NREN development in the Arab countries. Nine countries have mature NRENs built and operated by a national organization. Five countries have working NRENs, and the remaining eight countries have started NREN development at the national level.

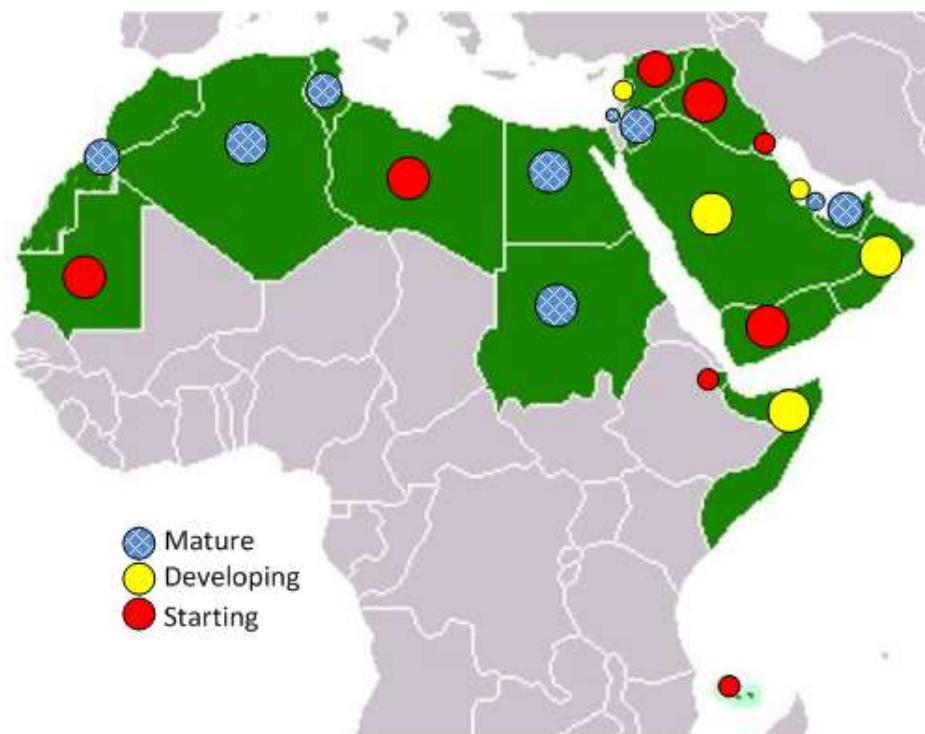


Figure 1: Status of NREN development in the Arab region

Except in Comoros and Syria, ASREN has made a tremendous effort in all Arab countries to promote research and education network connectivity and support linkage to the global e-Infrastructures. Since its inception, ASREN has organized several specialized workshops at the national levels and has invited communities of different sorts to ASREN's annual conferences. Currently, most of the Arab countries are aware of the importance of creating NRENs in their countries.

Today in the Arab region, there are 12 countries that have developed NRENs and 9 countries that have initiated the development of NREN. Libya, Yemen and Syria started some work but it is now frozen due to the current political situation. The details and statistics presented in the next section are based on the survey analysis conducted as part of the FP7-funded CHAIN project, and have been published in a comprehensive report.

4.1 Algeria research network - ARN

The Algeria Research Network (www.arn.dz) provides connectivity services to research institutions through a structured IP broadcast and multicast service that enables communication at the national and international levels through the European GEANT and the worldwide Internet. The technical setup of the network is based on a 2.5 Gbps backbone connecting 120 universities, institutions, and research centers, for a total of about 600,000 users.

4.2 Egyptian universities network - EUN

The Egyptian Universities Network (www.eun.eg) was founded in 1985 under the umbrella of the Supreme Council of Universities to serve the higher education community at large. Currently, EUN links all Egyptian universities through two main ISPs at a speed that ranges between 34 Mbps and 1 Gbps. It has a 930 Mbps (Six STM1) international link to the Internet and a 34 Mbps one to Internet2. The available infrastructure at EUN is a 68-Core CPU running the EMI-gLite middleware for Grid computing.

4.3 Jordanian universities network - JUNet

The Jordanian Universities Network (www.junet.edu.jo) is a non-profit company connecting the Jordanian Public Universities via a state-of-the-art high-speed broadband network creating the best infrastructure needed for advanced Higher Education and Research in Jordan. JUNet owns a national broadband network with 1 Gbps fiber optic cables connecting public universities at the national level. The network runs an 8 CPU core Grid system accessible through the EMI-gLite middleware. ASREN has established a 155 Mbps linkage to its PoP in London and has made the technical arrangements to connect the regional center: SESAME - Synchrotron-light for Experimental Science and Applications in the Middle East.

4.4 Lebanon national research network - LNREN

The initiative to build the Lebanese National Research Network began in 2011 with discussions between the Ministry of Education, the National Council for Scientific Research - CNRS, and ASREN. Connectivity is available on individual basis to the commercial Internet with no interconnection either in between universities at the national level or to the Global REN. Currently, the American University in Beirut in cooperation with CNRST and other Universities is leading the establishment of LNREN and is interested in wider international connectivity. AUB is now connected to ASREN PoP in London at 10 Mbps.

4.5 Morocco academic and research network - MARWAN

The Moroccan Academic and Research Wide Area Network (www.marwan.ma) is the national computer network that is dedicated for education, training and research. It is an information infrastructure connecting educational institutions and is run by the National Center for Scientific and Technical Research (CNRST). It offers institutions and universities a choice of speed from 2 to 100 Mbps. The available Grid infrastructure at CNRST is a 60 CPU core system with 12 TB of disk storage available for Grid computing services at the national level.

4.6 Oman research and education network - OMREN

The Oman Research and Education Network is meant to be the national e-Infrastructure with high-speed backbone connectivity, connecting all research and education organizations and entities. The current state analysis of OMREN is to identify the capabilities of the existing private and public telecommunications network infrastructure (technical, financial and commercial aspects), then to ascertain industry trends and assess which approach most suited to meet key objectives set out for OMREN, namely, (<http://www.trc.gov.om>).

4.7 Palestinian national research and education network - PalNREN

The Palestinian National Research and Education Network (www.palnren.net) is a network connecting the Palestinian universities electronically. The purpose is to help communicate and exchange services and information between Palestinian universities through providing educational content and experiences. PalNREN connects most of the national universities through Paltel operator.

4.8 Qatar national research and education network - QNREN

The Qatar Foundation Research and Education Network (www.qf.edu.qa) has started the process of setting up a dedicated RE infrastructure linking the Qatar Science and Technology Park (QSTP), Education City, and the Qatar Foundation's headquarters. The infrastructure network is based on a 40 Gbps backbone linked with a 1 Gbps to the US Internet2 network. Recently, Qatar University was mandated to establish the official Qatar NREN (QNREN) to be the official National RE network for Qatar and is now connected to both GEANT and Internet2.

4.9 Saudi academic research and innovation network

The Internet Services Unit at the Saudi Arabian King Abdulaziz City for Science and Technology (KACST) has been working on establishing the NREN of KSA and is now connected to Internet2. King Abdullah University of Science and Technology is also connected to Internet2 and GEANT at 10 Gbps since 2011.

4.10 Somali research and education network - SomaliREN

The Somali Research and Education Network (www.somaliren.org) has a goal is to promote research and quality higher education among the Somalis. It is a network whose members include the major Somali higher education institutions and exists for the sole purpose of bringing them together to collaborate on issues that matter not only to them but also to the Somali community at large. Now SomaliREN will be connected to GEANT via Ubuntunet Alliance under the africaConect2 Project.

4.11 Sudanese research and education network - SudREN

The Sudanese Research and Education Network (www.suin.edu.sd) is a specialized Internet Service provider dedicated to supporting the needs of the research and education communities within Sudan. SudREN connects more than 40 public and private research and education institutions. The network is based on the national fiber network owned by Sudatel Telecom and Canar Telecom companies. SudREN's operating bandwidth is 155 Mbps and has two Points of Presence (POPs) hosted by the University of Khartoum and the Sudan University of Science and Technology.

4.12 Syrian higher education and research network - SHERN

The Syrian Higher Education and Research Network (SHERN) has been created as a result of the cooperation between UNDP, UNESCO and the Ministry of Higher Education. The Higher Institute of Applied Science and Technology – HIAST (www.hiast.edu.sy) has been active in leading e-Infrastructure and connectivity at the national level and developing SHERN. SHERN builds a modern core network within the different Syrian universities and connectivity between them and other education and research institutions. Due to the current situation in Syria, SHERN has no international link to the global research and education network.

4.13 Tunisia national university network (RNU)

The Tunisia National University Network has been established by the Tunisian Computing Center el Khawarizmi – CCK (www.cck.rnu.tn). Since 1997, as Internet service provider, CCK has been providing Internet services for the sector of the scientific higher education and scientific research. RNU interconnects all universities, teams and research labs and administrative services through a mesh network. RNU will connect to GEANT at 1 Gbps soon under the support of AfricaConnect2 Project and ASREN.

4.14 United Arab Emirates advanced network for research and education - Ankabut

United Arab Emirates - UAE's leading universities formed Ankabut (www.ankabut.ae) as a dedicated research and education network within the country. Ankabut caters for the regional educational and research needs, offering great improvements in how research is conducted, as well as improving the teaching and learning processes. It also provides collaboration and sharing of resources. The available network bandwidth at Ankabut is 155.52 Mbps international link and interconnects over 56 UAE university Campuses with a 10 Gbps backbone and 1 Gbps access links. It is a host of a 60 CPU core system running the EMI-gLite middleware for Grid computing and a 64 CPU core High Performance Computing Cluster of 1.2 TFlops over the Cloud.

4.15 Remaining Arab countries: Bahrain, Comoros, Djibouti, Iraq, Kuwait, Libya, Mauritania, and Yemen

In Bahrain, several initiatives started with Bahrain University and Bahrain e-Government to launch the development of a research network at national level. No reports are available on both Comoros and Djibouti developments for research and education network at the national level. In Iraq, development started as an initiative of the Ministry of Higher Education to support the development of Iraqi national research and education network. In Kuwait, UNESCO-HP Brain Gain initiative supported the development of Kuwait University (KU-01-KUGRID) Grid site. Similar initiatives are proposed for the Ministry of Higher Education in Libya, with no solid actions taken yet. No reports are available on the development of research and education network in Mauritania and Yemen.

These results show important network characteristics that need to be taken into account for a further enhancement and development. These include availability and maturity of the network operation centre in providing network services and circuit management, development of optical points of presence (PoPs) to serve wider research communities and linking to neighbouring academic backbones, and establishing external links dedicated for research and education traffic.

5. NETWORK DEVELOPMENT

The network development supports the establishment of a high-speed communication network for research and education to provide Arab scientists with a gateway to global research collaboration. AfricaConnect2 (AC2) and EUMEDCONNECT Projects provide opportunities for the realization of the network objectives aiming at developing international connectivity, hubs, cross-border interconnection, and eventually pan-African network integration.

ASREN has supported the development of national networks in a number of Arab countries as well as international connectivity in the context of the EUMEDCONNECT and AfricaConnect2 Projects. It operates closely with its shareholders and partners in the Arab countries. In EUMEDCONNECT all connectivity was tendered and contracted by GEANT, with ASREN providing a support and outreach role. In AC2 ASREN plays a direct role in network provision through its own connectivity contracts and possibly in the future by taking over contracts initially established by GÉANT.

With donations from ISOC and support of Cisco, ASREN has established its first Point of Presence (PoP) in London at Telecity Harbor Exchange with ASR1002-X Cisco router. It provides IP interconnection with GEANT, international transit routes, and interconnection in-between ASREN and WACREN partners. It also provides accessibility over variety of interfaces including optical, Ethernet, and SDH/SONET circuits. The management of serviceability of ASREN PoP is integrated as part of GEANT NOC with a support of 24 x 7 over 365 days a year.

ASREN has currently contracted STM1 circuit with a capacity of 155 Mbps that connects Jordan and a virtual circuit with a capacity of 10 Mbps that connects the American University in Beirut to its PoP in London. The link to Algeria has been upgraded to 2.5 Gbps and routed via GÉANT in Marseille and the link to Egypt is operated by ENSTINET and routed via GÉANT in Amsterdam.

ASREN operates and manages its Network Operating Centre (NOC) in Amman and London. Its London NOC is supported by GÉANT and is closely coordinated with GÉANT engineers to facilitate direct bypass of interconnects on a global scale between research and education networks; enable direct traffic routing, bilateral peering, and interconnections based on different types of technologies and protocols; support an open connection policy; and reduce costs of conventional interconnections.

5.1 International connectivity

In the past, international connectivity in the North African region has been extremely expensive compared to more developed world regions such as Europe. Competition and deregulation has been weak or non-existent in many countries despite EU efforts over the last 10 – 15 years. While more and more cost efficient cable systems are now available which means that unit costs of providing circuits on them are much lower, the major cost reductions seen in Europe or North America have not yet materialized for North Africa.

This is due to the fact that most of the investment in modern cable infrastructure has been directed to new business opportunities between Europe and the Gulf States and onwards to India and the Far East. These cables tend to land at Marseille and Egypt at Alexandria but rarely in other North African countries. Most cables connecting the other North African countries are bilateral cable systems connecting individual countries with a European country and are less competitive routes.

Although sea cable costs are reducing to some extent in most of the North African countries, still the cables are dominated by a national incumbent provider, with a total or near total monopoly, which means competition at operator level is lacking. ‘Last mile’ costs between the cable landing stations and the partner site can normally only be provided by the incumbent and can add significantly to the total costs. Although Morocco is exceptional in having 2 alternate licensed operators, initial market experience suggests international connectivity prices remain high.

5.2 Connectivity hubs

Network hubs are vital for routing traffic exchanged by the NREN partners with each other and globally. They allow traffic to be concentrated, thus achieving economies of scale. By siting them in convenient locations they minimize the distances, and hence also transmission delays, of the traffic that is carried and their locations can also significantly reduce overall network costs.

Currently, the Arab States Research and Education Network has created a hub in London that interlinks regional traffic with GÉANT and other regional networks. Figure 1 depicts the layout of the international Submarine Cables, and shows Egypt as a strategic geographical location for an optimum utilization of traffic to become a regional and global Hub for the exchange of research and education traffic in the African region. Marseille seems to be another viable peering point with GÉANT since Telecom operators in Algeria and Tunis find it more a convenient and cost effective landing point in Europe. In the meantime, GÉANT network can be used for peering of local traffic among the northern African countries between London and Marseille. In the future there are opportunities for further exchange points that could serve the region and be more cost effective for certain traffic.

- UAE Giga PoP: (Arabian Global Educational Open eXchange AGE-OX) is aggregating research and education traffic of the GCC countries, to be set up in cooperation with ANKABUT and Etisalat.
- Egypt Open Lightpath Exchange: aggregating research and education traffic of the Eastern Mediterranean countries and southern African Arab countries, to set up in cooperation with TE Data and Egypt Telecom.

In the short term, UAE and Egypt aggregation sites represent the main landing point for a large number of international submarine cables, and would be expected to carry traffic originating from the Gulf and many other Arab countries and potentially offer convenient interconnection points between Europe and Asia. However, connecting to these exchange points is still expensive today compared to London PoP. This is due mainly to the high prices of telecommunication in the last mile connection. In the longer term, a prospective ASREN topology is shown in Figure 2.

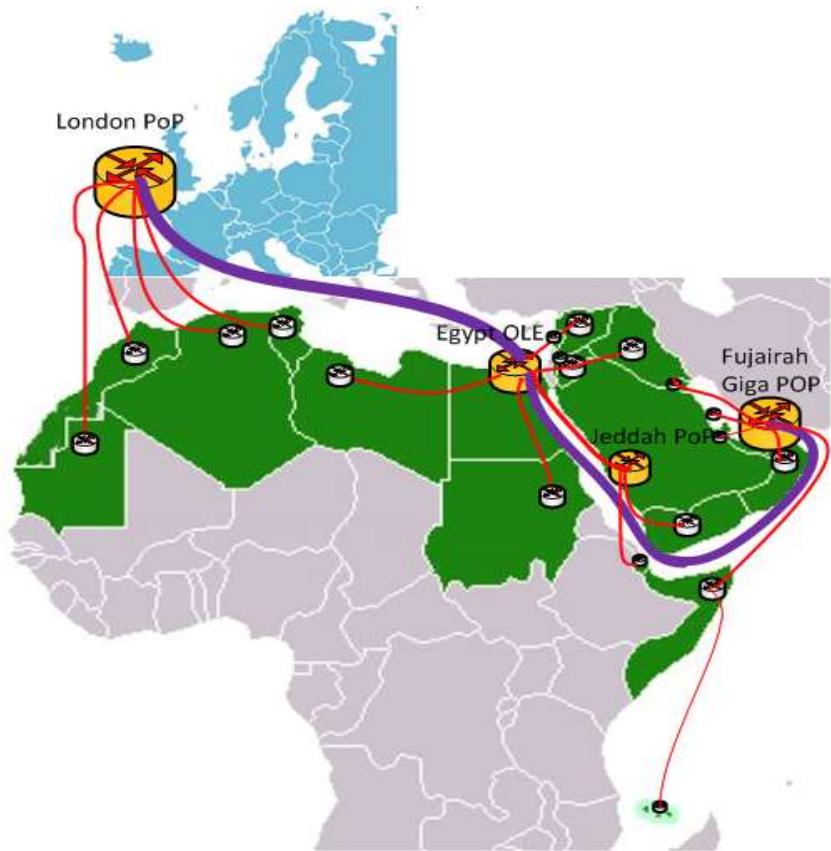


Figure 2: Prospective Pan-Arab network topology

The topology includes the main aggregation points in UAE and Egypt and linking to ASREN PoP in London. Morocco, Algeria, and Tunis are likely to stay interlinked with Europe. Additional ASREN exchange points would serve as the main connectivity hubs for the region with world research and education networks and big data providers, including cloud service providers. They are expected to bring connection points for NRENs and big data providers, worldwide, hosting additional connection points for adding resilience and richer connectivity.

6. THE EU COOPERATION PROJECTS

The EU cooperation project to support the Arab Mediterranean countries in Grid Computing and e-Infrastructure services started twelve years ago. The objective has been to foster information society and develop high speed connectivity in higher education institutions. The EUMEDCONNECT, EUMEDGRID, and Africa Connect series of projects have been recognized as important cooperation projects that are co-funded by the European Commission under their Framework Programmes.

6.1 AfricaConnect2 Project

AfricaConnect2 is co-funded by the EC with an objective to develop high-capacity Internet networks across the entire African continent and connect them to the European GÉANT network, allowing students, researchers and academics to collaborate with their peers from around the world. The connectivity boost not only advances research and education in Africa with opportunities like e-learning and cloud computing, but also benefits global scientific studies in areas such as climate change, biodiversity, food security, malaria and other infectious diseases.

A central part of the recently announced Africa – EU partnership, AfricaConnect2 fulfils both continents wish to connect research and education communities across borders and accelerates scientific breakthroughs. It builds on existing networks in Eastern, Southern, and North Africa and will extend connectivity into West and Central Africa.

By collaborating with AfricaConnect2, the pan-European GÉANT network strengthens Europe's links with the African continent and provides African research and education communities with a gateway for global collaborations.

6.2 EUMEDCONNECT Project

EUMEDCONNECT established a regional research network in 2004, then extended as EUMEDCONNECT2 in 2008 and EUMEDCONNECT3 in 2011. The network maintains high bandwidth connectivity to the Mediterranean research and education communities serving over 2 million researchers, academics and students in seven southern Mediterranean countries - Algeria, Egypt, Jordan, Morocco, Palestine, Syria and Tunisia. With its direct links to its pan-European counterpart GÉANT, the network facilitates the participation of the Mediterranean community in world-class research and education initiatives. The network has points of presence (PoPs) in Sicily, at Catania and Nicosia, Cyprus, while some countries connect via links to the GÉANT network. Access capacities range from 34 to 622 Mbps and circuits are connected in each case to the EUMEDCONNECT partners' national research and education network.

The EUMEDCONNECT network has served as a backbone for many research initiatives. EUMEDGRID was initiated in 2006 as an e-Science development project targeting communities in different domains, including physics, hydrology, bioinformatics, engineering, and archaeology.

6.3 The EUMEDGRID infrastructure

EUMEDGRID aimed at fostering e-Science and promoting e-Infrastructures in the Mediterranean region. Several Grid sites have been established to support research communities in accessing Grid Computing facilities and resources. Efforts are underway to support sustainability and integration between Grid-based e-Infrastructures. Now, there exists 36 Sites in 11 countries, providing Grid services based on the EMI-gLite middleware, for a total of around 4,000 CPU cores and 600 Terabytes of disk storage capacity.

EUMEDGRID has also contributed to raising awareness about the importance of e-Infrastructures for the development of the region and the creation of strategic partnerships the EUMED countries. Several conferences, workshops, and forums have been organized to allow policy makers and education stakeholders to meet and exchange ideas to help support sustainability of the EUMED e-Infrastructure.

The Grid-based e-Infrastructure has provided support to many scientific domains and applications in physics, fluid dynamics, social science and humanities, engineering, computing science and mathematics, and bioinformatics. Several training events, from tutorials to schools, have been held in the region allowing local scientific communities to port and configure their applications on the EUMEDGRID infrastructure. General and reference applications and tools in different scientific domains have been deployed to provide scientists with portfolio of popular applications and tools including: ROOT, GCC 4.3, Octave, BLAST, Fluent, OpenFOAM, and Rosetta.

The EUMEDGRID infrastructure supports the execution of parallel applications using the OpenMP and MPICH2 protocols for message passing, thus allowing the inclusion of HPC Clusters within the infrastructure. It has also contributed to consolidating best practices and standards for enabling transparent e-Infrastructure provisioning to scientists worldwide across different regional initiatives and permanent infrastructures, such as the EU flagship initiative, EGI. In the longer term and in the framework of the CHAIN-REDS project, it is planned to establish interoperation and long-term sustainability to regional initiatives and linked together.

6.4 The Africa & Arabia Regional Operation Centre

The Africa & Arabia Regional Operation Centre (ROC - roc.africa-grid.org) has been created as a coordination and support point for all sites in the two regions, participating in the stimulating and challenging endeavour of creating a common Grid infrastructure to foster e-Science. It was set up to monitor, control and manage both the EUMEDGRID and the South African Grid infrastructures, including a user support ticketing system, Grid and Network monitoring based on reference tools adopted by international Grid projects and initiatives.

The ROC site facilitates a dynamic map to show both the sites belonging to the Africa-Arabia ROC and those sites belonging to other ROCs but participating in common projects. The site allows users to get more information on the Grid cooperation status, facilitates monitoring of activities, and helps system administrators to install the Grid middleware on their sites.

6.5 CHAIN and CHAIN - REDS

CHAIN - Coordination Harmonization of Advanced eInfrastructure Networks and its extension to CHAIN-REDS are two FP7 projects that aimed to establish interoperation and long-term sustainability to regional initiatives and linking them together for a broader coordination and harmonization of advanced e-Infrastructures. The purpose is to promote and support technological and scientific collaboration across different e-Infrastructures that are established and operated in various continents, in order to define a path towards a global e-Infrastructure ecosystem. This allows Virtual Research Communities (VRCs), research groups and even single researchers to access and efficiently use worldwide - distributed resources (i.e., computing, storage, data, services, tools, applications).

6.6 MAGIC

MAGIC – Middleware for Collaborative Applications and Global virtual Communities seeks to establish a set of agreements for Europe, Latin America and other participating World Regions, aiming at consolidating and completing the building blocks of middleware necessary for the establishment of a marketplace of services and real-time applications for international and inter-continental research groups which facilitates mobility and the work of global science communities. The main activities in the MAGIC include the support of mobility of researchers through the provision of eduroam and federated access services at the global level. The purpose is to establish global science communities and to provide them with collaboration tools at the global level.

6.7 OPEN

OPEN - Opportunity Platform towards transformative higher Education and innovative research Network is a DAAD funded project to support exchange of students and staff. This will manifest a long-term cooperation with Moroccan higher education institutions and scientific networks to set the seeds for a transformation of higher education towards the implementation of open source

technologies at the partner universities and beyond. OPEN also supports the creation of an innovative research network through which a comprehensive backbone of Arab – German community of practice is created to promote joint research and innovation.

7. EVENTS

Integrating Arab e-infrastructure in a Global Environment e-AGE, is an annual international platform conducted by the Arab States Research and Education Network, ASREN. Since launched in December 2010 at the League of Arab States, it was decided to have this annual activity moving from one Arab country to another. e-AGE comes in line with ASREN's major objectives related to creating awareness, promoting R&E collaboration and joint activities and establishing human networks in order to facilitate collaboration and cooperation among researchers and academicians in the Arab region and the rest of the world.

e-AGE is meant to be the launching pad for R&E connectivity and cooperation. It brings together the stakeholders and the region's foremost innovators, leaders, scientists, and businesses to discuss and debate new models of innovation, integration of R&E networks, policies for sustainable development in education, means of knowledge sharing and dissemination, capacity building programs, and region-wide e- infrastructure deployment to tackle today's crises in climate change, global economy, food, water scarcity, alternative energy, and environmental issues. The e-Infrastructures are evolving in the Arab region at both national and regional levels as more than 15 Arab countries now have NREN in place or starting their NREN.

For more insights on the outcomes and reports of eAGE, please visit:
<http://www.asren.org.net/?q=content/e-age>

7.1 e-AGE 2016

Following on from the success of e-AGE in 2011, 2012, 2013, 2014 and 2015, e-AGE 2016 will be held at the American University of Beirut, during 1-2 December 2016. In e-AGE 2016, the main focus will be on connectivity, users, applications, services, and inclusion of stakeholders in research and education and related services in order to enable and facilitate collaboration and resources and knowledge sharing. Discussion sessions, panels, meetings and workshops will be scheduled to present and exchange research and education experience and innovations. e-AGE 2016 is coming with “Ubiquity and Cohesiveness of e-Infrastructures” as the main theme of the conference.

Moreover, special sessions will be dedicated to specific domains, mainly focusing on experiences in connectivity and e-Infrastructure, applications and services across a variety of scientific domains. It will also demonstrate how research infrastructure creates tangible benefits to communities and collaborations. Different discussions will be stimulated during e-AGE 2016 to drive outcomes and concrete results on practical steps towards developing a regional e-Infrastructure.

7.2 e-AGE 2015

The 5th International Platform on Integrating Arab e-infrastructure in a Global Environment, e-AGE 2015, took place in Casablanca during December 7-8, 2015 Under The High Patronage of His Majesty King Mohammed VI of Morocco. e-AGE 2015 came focused on “Revealing and Harvesting Knowledge” as the main theme of the conference and all activities will be centred on it. It was attended by more than 120 academics, network professionals, researchers, scientists, and high -level decision-makers from governments, enterprises, NGOs, embassies, academia, and civil society. The e-

AGE Platform became a very important venue for networking among experts and scientists from all over the world.

Representatives from many countries participated in e-AGE meetings including Algeria, Australia, Bahrain, Belgium, Brazil, Brussels, Canada, Chile, China, Cyprus, Egypt, Ethiopia, France, Germany, Ghana, Greece, Iraq, Ireland, Italy, India, Jordan, Lebanon, Libya, Malawi, Malaysia, Morocco, Netherlands, Oman, Palestine, Poland, Qatar, Saudi Arabia, Singapore, Somalia, South Korea, Spain, Sudan, Sweden, Switzerland, Tunisia, Turkey, the UAE, the UK, the USA and Yemen.

7.3 e-AGE 2014

The 4th International Platform on Integrating Arab e-infrastructure in a Global Environment, e-AGE 2014, took place in Muscat during December 10-11, 2014 Under the Patronage of His Highness Sayyid Taimur Bin As'ad Al Said, The Research Council, Oman. In e-AGE 2014, the main theme was "Intercontinental Connectivity of the Pan Arab Network". ASREN started concrete steps towards interconnecting researchers and academics across the Arab states by launching its first PoP in London Telicity and working with its partners on new PoPs in the UAE, Egypt and the Maghreb region. ASREN is also supporting the development of National research and education networks (NRENs) in some Arab countries. ASREN gave special attention and more focus on users and how the e-Infrastructure can support their needs in terms of services and applications.

More sessions were dedicated to the users to present their research and education activities and then to identify how these users can be better served by NRENs. Moreover, special sessions were dedicated to specific domains, mainly focusing on experiences in connectivity and e-Infrastructure, applications and services in variety of scientific domains, and case studies with impact indicators and measures. The sessions also show how research infrastructure created benefits to communities and collaboration. It is still critical to show how research connectivity can promote collaboration and innovation. Different discussions were stimulated during the conference to drive outcomes and concrete results on practical steps towards developing a regional e-Infrastructure.

It is worth mentioning that e-AGE 2014 has proudly witnessed the first complete gathering of Arab National Research and Education Networks.

7.4 e-AGE 2013

After 2 years of success in bringing together high level and wide range of participants from many countries around the world, e-AGE 2013 was planned on the basis of three main themes: Connect ---> Access ----> Innovate. e-AGE 2013 was held under the Patronage of His Excellency Moncef Ben Salem, Minister of Higher Education and Scientific research of Tunisia and hosted by The Computing Center Al Khwarizmi (CCK). e-AGE 2013 spanned for full week 9-13 December 2013 with events and workshops on variety of topics.

In addition to this, e-AGE 2013 witnessed the signature of MoU between Ministry of Higher Education and scientific Research of Iraq and ASREN. ASREN also announced the operation of its first PoP in London Telicity.

7.5 e-AGE 2012

The 2nd International Platform on Integrating Arab e-infrastructure in a Global Environment, e-AGE 2012, took place in Dubai during December 12-13, 2012 under the Patronage of His Excellency Nahyan Mubarak Al Nahyan, the UAE Minister of Higher education and Scientific Research. e-AGE 2012 was attended by academics, network professionals, researchers, scientists, and high level decision makers from governments, enterprises, NGOs, academia, and civil society.

Representatives from the following countries participated in e-AGE 2012 meetings: Jordan, Palestine, Egypt, UAE, Saudi Arabia, Oman, KSA, Algeria, Tunis, Morocco, Lebanon, Sudan, Qatar, Somalia, Cyprus, USA, Italy, Netherlands, Switzerland, Belgium, Germany, Greece, UK, Bahrain, Dominican Republic, Yemen, Nigeria, Afghanistan, Czech Republic, Ghana, Zimbabwe, China, Latin America, Malawi, Cameroon, India, Spain, Rwanda, Belgium and Ivory Coast.

7.6 e-AGE 2011

The 1st International Platform on Integrating Arab e-infrastructure in a Global Environment, e-AGE 2011 took place in Amman during December 12-14, 2011 under the Patronage of His Majesty King Abdullah II ibn Al Hussein. It was attended by more than 200 high level representatives, including ministers, policy makers, academics, network professionals, researchers, scientists, and government officials from 30 different countries.

In conclusion, participants emphasized that Arab countries face scientific, knowledge, and cultural challenges and that Arab youth, representing experts, specialists and researchers, are knowledge creators towards innovation and development - “the best way to predict the future is to create it”. e-Infrastructures support the development of knowledge through access to resources, computing facilities and services.

7.7 ASREN Launch 2010

ASREN has been officially launched under the patronage of the HE Mr. Amre Moussa, the secretary general of the League of Arab States in Cairo during December 8-9, 2010. The overall achieved results include:

- ASREN was launched under the patronage of HE Mr. Amre Moussa who also accepted to be the Honorary Chair of ASREN.
- The event was attended by high level participants from the European Commission (EC), Turkey, Italy, UK, France, and representatives of most of the Arab countries.
- Many Arab countries and organizations signed statements of support to join ASREN with intention to support the developments of ASREN.
- Positive signs were perceived about the financing of EUMEDCONNECT3.
- High level participation from the private sector was also an excellent sign indicating that there will be good opportunities for partnership with private sector and researchers.

7.8 Workshops

ASREN conducted several workshops for capacity building in variety of topics. These include:

7.8.1 Workshop on Joining eduroam and Identity Federation

ASREN - Amman, Jordan: 8-10 September, 2015

Topics:

- eduroam: is the secure, world-wide roaming access service that allows any user from an eduroam participating site to get network access at any institution connected to eduroam.
- Federated Access: effective and secure management of authentication and identity information to build a trusted environment where users can be identified electronically using a single identity to login and access variety of available resources and applications worldwide.
- eduGAIN: is a service that interconnects identity federations around the world, simplifying access to content, services and resources for the global research and education community.

7.8.2 Clouds for Research and Education Workshop

GAAR - Rome, Italy: 24-26 June 2014

Topics:

- Business and technology trends in Cloud Computing.
- Proprietary and Open Standard based Cloud Solution.
- Open Standards and Interoperability Assess the potential of Open Source applied to Cloud Computing and explore its Business Model.
- Cloud Computing through labs and practical experience.

7.8.3 Building federated identity infrastructure

ASREN – Amman - Jordan, 17 -18 June, 2013

Topics:

- Federated Identity Infrastructure setup in NRENs and Campuses using mesh, hub and spoke and centralized login.
- Practical skills in deploying federated identity and service provider services using simple SAMLphp and Shibboleth.
- Knowledge to set the direction for library, campus and country identity federation activities.
- Skills to write a federation policy that will allow inter federation with the global research and education community.

7.8.4 Network management tools for NREN NOCs

CCK – Tunis: 9 - 11 December, 2013

Topics:

- Network Management Concepts and basics of IOS configuration for Network Management.
- Simple Network Management Protocol and performance tools: Graphing using Cacti (including best practices and automation) and Latency and jitter monitoring with SmokePing.
- Service monitoring using Nagios to monitor system and service availability.

- Auditing and security: Log management and monitoring tools and techniques; configuration management and auditing with RANCID; and traffic analysis and exploration with NetFlow.
- Network documentation with Netdot and Ticketing systems.
- Demo of perfSonar (psPS): Service oriented network monitoring and throughput measurement tools.

7.8.5 NREN Development Workshops

ASREN has organized several NREN development workshops in:

- Lebanon: June, 2011
- Kuwait: May, 2012
- Bahrain: October, 2013
- Iraq: December, 2013

8. PLANING

The following represents a summary of ASREN planning in the short-term. The plan focuses on including of new shareholders; supporting the development of Arab NRENs; connecting more NRENs to the ASREN/ AC2/EUMEDCONNECT3 network; maintaining ASREN PoP in London and developing new PoPs; building ASREN physical network; providing network services; organizing workshops to support building capacity in new technologies; and focusing on dissemination and sustainability. ASREN plans for the following steps in each dimension:

A- Shareholders:

Step 1: Complete in-process shareholders: Somalia, Algeria, Palestine, Iraq

Step 2: Recruit new Arab NRENs: Lebanon, Qatar, Oman, UAE, Mauritania

Step 3: Organize Shareholders' meeting in Lebanon during e-AGE 2016

B- Support developing NRENs

Step 1: Continue on-going discussions with Lebanon

Step 2: Continue on-going discussions with Mauritania

Step 3: Explore options for Kuwait, Bahrain, Saudi Arabia, Djibouti, Mauritania, and Comoros

C - Support AC2/ EUMEDCONNECT3/ ASREN Partners

Step 1: Liaison with partners to reconnect to the AC2/ EUMEDCONNECT3/ ASREN network: Morocco, Egypt, Lebanon, SESAME/ JUNet,

Step 2: Operate and Maintain ASREN PoP in London connecting Arab NRENs to world NRENs

Step 3: Follow up on the implementation of AGE-OX and Egypt OLE

- Cooperation agreement
- Last mile connection competitive pricing
- Peering with regional RENs

Step 4: Provide network services and access to scientific applications and resources to ASREN shareholders through partnership with regional networks

D- Capacity building

Step 1: Organizing workshops

- Survey of topics of interest to EUMED/ASREN partners as well as Arab NRENs
- Identity federation workshop in May, in Amman
- Network management workshop in September, location to be identified

E- Projects

Step 1: On-going MAGIC – Regional partners

Step 2: On-going OPEN – Morocco, Germany

Step 3: New project prospects

F- Dissemination

Step 1: Website

Step 2: Newsletter and distribution to contact databases

Step 3: Social Media

Step 4: e-AGE 2016 in Lebanon

G- Sustainability

Step 1: Developing proposals for funding

Step 2: Membership

Step 3: Generate revenues through providing services to users - consulting, training

In the long-term, ASREN's plan is to create a sustainable "Arab Connect" high-speed network compatible to GÉANT and Internet2, with larger scale of network and science services in research and education domains.

9. Conclusion

A five-year report of ASREN's development is presented. The report outlines the importance of research and education networks at the national and regional levels. It provides details on the pan-Arab e-Infrastructure lead by ASREN and associated services in the context of the EC funded projects: EUMEDCONNECT, AfricaConnect, EUMEDGrid, CHAIN and CHAIN-REDS, MAGIC, and OPEN. It also provides details of workshops and e-AGE annual conferences as means for capacity building, awareness, and connectivity platforms. The pace of development in the five-year time frame has largely contributed to the success of ASREN in supporting research communities across the Arab region. Its five-years plan is to create a sustainable "Arab Connect" high-speed network compatible to GÉANT and Internet2, with larger scale of network and science services in research and education domains.

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