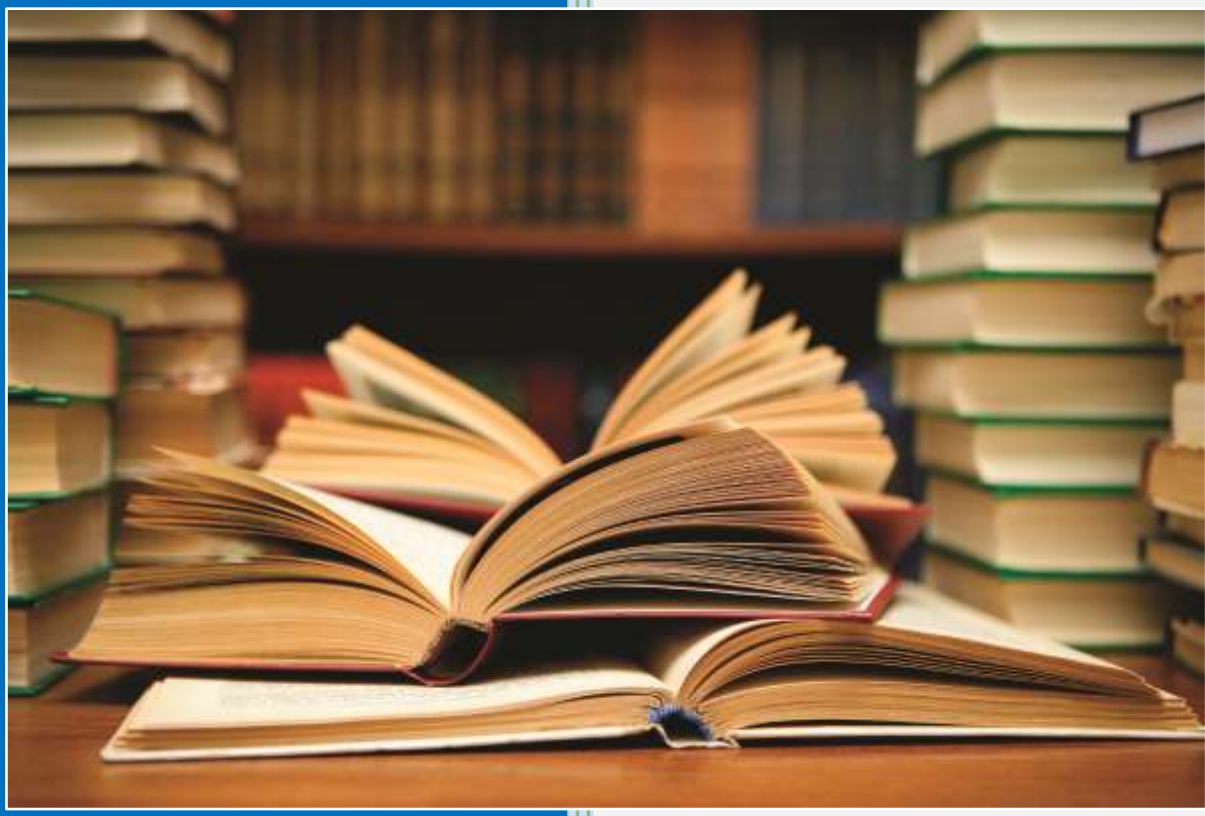
ASREN
Arab States Research and Education Network

Proceedings of

The 4th International Platform on Integrating Arab e-Infrastructure in a Global Environment

e-AGE 2014

10 - 11 Dec, 2014
Oman, Muscat



eage2014.asrenorg.net

www.asrenorg.net

The 4th International Platform on Integrating Arab e-Infrastructure in a Global Environment e-AGE 2014

Program Committee

- Ahmed Dabbagh, Emirates Identity Authority, UAE
- Boubakar Barry, West and Central African Research and Education Network (WACREN), Senegal
- David West, Delivery of Advanced Network Technology to Europe (DANTE), UK
- Federica Tanlongo, Consortium GARR, Italy
- Federico Ruggieri, The Italian National Institute of Nuclear Physics (INFN), Italy
- Habib Youssef, The Computing Center Al Khwarizmi (CCK), Tunisia
- Helga Spitaler, Delivery of Advanced Network Technology to Europe (DANTE), UK
- Johnathon Chapman, US Internet2 Special Interest Group Middle East (Internet2 SIG), Qatar
- Mwaffaq Otoom, Yarmouk University (YU), Jordan
- Ola Samara, Arab States Research and Education Network (ASREN), Jordan
- Salem Al-Agtash, German Jordanian University (GJU), Jordan
- Sara Al-Eisawi, Arab Organization for Quality Assurance in Education (AROQA), Jordan
- Yousef Torman, Arab States Research and Education Network (ASREN), Germany

Scientific Committee

- Ahmed Dabbagh, Emirates Identity Authority, UAE
- Federico Ruggieri, The Italian National Institute of Nuclear Physics (INFN), Italy
- Roberto Barbera, University of Catania, Italy
- Salem Al-Agtash, German Jordanian University (GJU), Jordan

Contents

An efficient Approach of e-Iris Enrolling and Authentication for FS e-Apps

R. Bremananth[(1)], Ahmad Sharieh[(2)]
[(1)]*Information Systems & Technology Department, Sur University College, Sur, Oman*
bremresearch@gmail.com / bremananth@suc.edu.om
[(2)]*Information Systems & Technology Department, Sur University College, Sur, Oman*
ahmadsharieh@suc.edu.om / sharieh@ju.edu.jo

Abstract: e-Enrolling and authentication is an essential task for any kind of e-apps (e-applications). In this paper, a frame work has been proposed on how to provide the e-enrolling and authentication for Financial Sector (FS) e-apps. E-iris and e-imaging security in the exiting official communication is an essential and challenging task in the present scenario. We suggest a method of e-imaging and feature extraction and provide e-authentication. A proposed frame work consists of e-enrolling related issues, e-authentication, cryptography for authenticating e-users, and e-iris sign in FS. Unlike other biometrics such as the fingerprint, palm, gait, retina, face, eras, and lips, the iris biometric is the best choice for deploying with the exiting e-apps. Because, an iris has many distinctive textures which are aptly computed and discriminated diverse e-users. In the e-enrolling, e-user has to enroll iris features through a Java run time (JRE) interface. A sequence of algorithm has been performed to localize e-user's iris and extract features. On successful enrolment, e-user can access FS e-apps based on the diverse level of options. Unlike traditional e-apps, e-iris system can provide more secure communication and avoiding multiple verifications. As result computational complexity of existing e-apps has been reduced by developing e-iris frame work. In addition, iris patterns of both eyes are chaotically distributed and well-matched to grant authentication to the genuine e-users throughout their lifetime with a single enlistment. In this frame work, we suggest e-imaging phase, e-authentication, cryptography tunneling, recover procedures, and deployment of e-iris system with existing FS e-apps. The proposed frame work has been implemented in JRE and tested with diverse kind of e-users in different real-life scenarios. This paper also includes some of implementation issues of e-iris system in the e-apps.

Keywords: Automatic recognition, Biometric, e-cryptography, e-enrolling, e-authentication, e-imaging, iris scanning, security access.

1. Introduction

E-banking and m-banking have grown rapidly in present scenario of official communication. The e-enrolling and e-authentication remain a problem. E-banking and e-governs are the common resource accessing by many people all around the world [1]. In present scenario of internet banking, some banks give user-id and password when a customer opens account in the bank. Some banks give user-id separately and password separately to their e-users. An alternatively, banks allow their e-users to register e-banking user-id and passwords through internet banking website. However, for each transaction, banks are communicating OTP (One Time Password) to every e-user through mobile or e-mail. An important question between e-users and the bankers is "Is it a really our customer accessing e-banking e-apps in person?" answer for this question from bankers' side is "who knows, any person perhaps know the user-id, password and mobile" can access e-banking or m-banking. For these reasons, all the banks are often scrolling message like "STOP!! Don't reveal your user-id and password to any one through any media" in their secured websites. The security problems related to e-banking and e-govern include not only unauthorized access to the e-applications (e-apps) but also modification of the existing information, making new transaction, accessing other related accounts or documents and remittance of transactions also. However providing authentication to the authorized person is a crucial process in order to minimize the access to all e-users.

As per 2014 Global economic crime survey [2], Financial Services (FS) organization was one of the first to be targeted by the cybercrime. FS respondents hailed from 79 different countries [2]. This report reveals that cybercrime is the second most common type of economic crime reported by FS respondents. Furthermore, cybercrime was in the year 2011 only 38% and 39% is in the year 2014. This report further shows that cybercrime will increase to 41% in next 24 months [2].
A cyber frauds survey conducted among public sector banks shows that approximately 1400000 US dollars loss in the year 2013 [3]. It is around 224000 US dollars more as compare to the FS report in the year 2012.

Another survey conducted among 154 depository institutions by Andrew M. Cuomo et al. [1] in New York 2014 reveals the cyber attacks, steal funds via account takeovers, need of information security framework, corporate governance around cyber security, and use of penetration testing in cyber security. In this survey [1], almost 90% reported having an information security framework in information security policy, risk management of cyber-risk, inclusive of identification of key risks and trends, information security audits & monitoring.

Furthermore, this report [1][2][3] shows the wide variety of security technologies to enhance systems security and thwart a cyber breach. Some of technologies are such as spyware and malware detection firewalls, server-based access control lists, intrusion detection tools, intrusion prevention systems, vulnerability scanning tools, encryption for data in transit, and encrypted files. Penetration tests are utilized to identify vulnerabilities between computer system, network or Web application to an attacker could exploit. Nearly 80% of the institutions conduct penetration testing on an annual basis. All these securities are required a secure access by the user with different authorization levels [1].

These security problems among FS organization motivated us to incorporate a frame work of e-iris enrolling and authentication methodology in the existing FS organizations.

Biometric identification can be utilized in a wide range of applications such as automatic recognition, computer login, passport administration, security entry, and access to privileged information, or any other off-line bank transaction [4][5][18]. However, one of the most perilous security oppression is subterfuge that some person argues somebody's income. Due to lack of security, unauthorized persons may get right to use confidential data or important accessories can be stolen. Hence, there is an essential requirement for person characteristic based authentication attributable to the fact that it can endow with the utmost fortification against subterfuge [5][11][12].

Based on biometrics and security literatures, deploying iris in the existing e-application will provide better enhancement in security and resolve certain security issues also. Iris is a unique pattern in nature. In fact, no two irises in the world are identical [4] [5] [9][10]. Even a person's left and right eyes have completely diverse patterns [5][11][12][13][14]. For this reason, as compare with other biometrics such as fingerprint, palm, gait, retina, face, eras, and lips, the iris can aptly be employed as a kind of living password in the e-application throughout the life time of human with single-time e-enrolment.

E-enrolling is an electronic process. Customer can register his or her authentication electronically through desktop browser or mobile browser. Especially in e-enrolling, user should properly register his or her iris biometric via the secure interface between camera and java interactive interface (JII). JII is an important application program interface (API) which conquests communication between customer and e-application. It also ensures whether e-customer has provided enough e-iris when acquiring eye and also assessing the quality of e-iris for registering in the database or not. A basic issue in e-iris enrolling is acquired in diverse angle of variation. We address this problem through e-rotation invariant pattern recognition algorithm.

Arching ligaments, crypts, radial furrows, pigment frill, pupillary area, ciliary area, rings, corona, freckles and zigzag collarette [4][5][15][16] are some of the biological features of the iris. It crafts a complex pattern which contains several unique digital signal features. These spatial patterns in the iris are unique in nature [5].

The key issue of biometric pattern recognition problem is the relation between bury and non-bury variability. That is, pattern categories can be efficiently differentiated only, if the variability between features of a given cluster is less than the variability between other clusters. In the e-iris recognition process, variability of iris non-bury cluster features are less than the bury cluster variability. In other biometrics recognition, such as fingerprints [9], palm[10] and face, bury cluster variability is greater than non-bury cluster variability. However, bury cluster variability is limited because different clusters hold the same basic set of features.

A frame work is proposed in this paper for e-iris enrolling and authentication. This is shown in Fig. 1. The e-iris is utilized in this paper, initially acquires eye images by testing the changes in diameter of pupil boundary from the same distance of capturing.

Subsequently, e-iris preprocessing, normalization, and enrichment phases are performed to make the iris patterns suitable for feature extraction process. Finally, the e-iris discriminator design phase classifies the irises. The core process of e-iris enrolling and authentication frame work is then incorporated with e-banking system in order to authenticate the internet users based on the diverse authorization of level of users. The main contributions to this paper are:

i. A frame work for e-enrolling using e-iris security system based on Iris pattern.
ii. Provide solution to e-iris authentication to diverse level of users.

The remainder of the paper is organized as follows. Section II describes the proposed frame work for e-iris e-enrolling and authentication. E-enrolling and authentication implementation results are illustrated in Section III. Section IV consists of concluding remarks on our paper.

1. Cyber security using e-Iris

Cyber security is an essential process for all e-banking transactions. Internet banking is mainly employed for viewing account information and remittance of entire transactions by invoking website of banking system from any kind of desktop. This process requires a complete cyber security in order to thwart a cyber breach. Our proposed frame work of E-enrolling and authentication has been depicted in Fig. 1. It consists of two main modules such as e-enrolling and e-authentication. E-enrolling is a process of registering biometric password of a valid user through any communication media. These media may be a secured desktop or a laptop or mobiles or other personal assistance systems. The users are requested by FS organization to enroll their biometric in this cyber secure. Once they have invoked a provided hyperlink with HTTPS (Hyper Text Transfer Protocol), then JII is linked by administrator and user can enroll his/her eye image through e-enrolling module. The user can register his or her left or right iris to access the internet banking.

Once authentication module is verified the enrolled e-iris, then e-user is allowed to access diverse hyperlinks available in the website. E-users are authenticated by scanning e-iris and e-imaging features with respect to its access code. If the opted level accesses are authorized to be permitted, then the e-authentication gives process to the opted hyperlinks otherwise rejects the current process and waiting for the next user request.

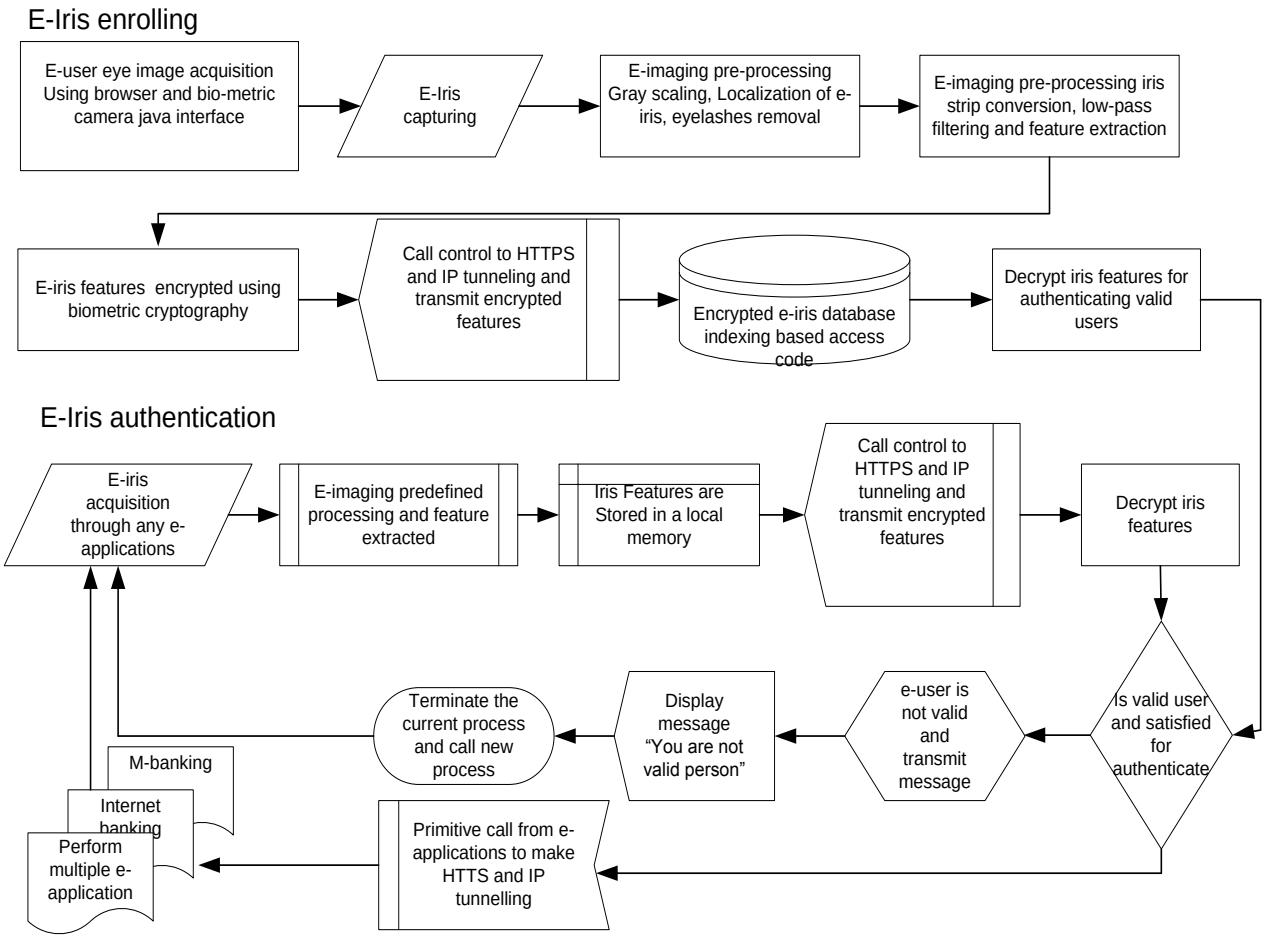


Fig.1 *A proposed frame work for e-enrolling and e-authentication.*

E-iris scanning and e-enrolling

A java enabled default browser is employed for e-user eye image acquisition. Especially, it is difficult to acquire clear e-images using the standard camera with ordinary lighting. A high resolution or biometric camera can utilize to capture the e-user's distortion-free eye images. Any camera with NIR (Near Infra Red) waves [4][5] passing is more suitable for explore the internal pattern of iris. However, an efficient algorithm can improve the quality of acquisition and feature extraction as well. Another important issue behind e-rolling is the e-iris acquisition distance. It is normally between 19 and 36 inches from the e-user and the camera, respectively. However, many algorithms have suggested for increasing capturing distance and angle variations [5][6][10][11].

Research on iris image acquisition has been made in non-invasive imaging with just a few meters distance of separation [12][13][14][15]. However, still e-iris acquisition is a computationally challenging problem. The e-image acquisition phase should consider three main aspects, namely, the lighting system, the positioning system, and the physical capturing system. Due to capturing distance, diverse angles and intensity variations, e-rolling and authentication may produce different recognition rates. Perhaps, the same genuine e-user's iris features may slightly vary at sunlight and twilight or room light reflections and angle variation in capturing. A challenging issue related with iris discrimination is how the system confines e-iris features. The Euclidean distance measures are employed for the confutation of diverse features of iris as compare to genuine users' features. Usually, in the e-enrolling e-iris images are captured without any eyewear that suitable to encode the iris features accurately.

Fig. 2 shows an applet viewer invoking "Irisenroll.class" for imaging e-eye with localization. It shows localization of inner and outer boundary of iris from the captured in e-eye image. The primary challenging issue for the localization algorithm is to locate iris which may appear anywhere in the e-image. It has many distortion artifacts such as eyelashes, eyebrows, eyelids, size of iris, size of papillary area, illumination changes, distance variation, spectacles or contact lens, and other eye-wears. Due lighting effect from the external source, reflection appears on primary portion of eye which influences certain changes in the patterns when e-enrolling. Some of eye-wear issues are depicted in Fig. 2.

Fig. 2 *Illustration of Inner and outer periphery filtering with eye-wear.*

E-imaging pre-processing consists of two phases. In the first phase, acquired three dimensional signals are converted into one dimensional signal. This process is aptly required for the convenient for convolution computation. Especially, for e-imaging, clients' e-iris signals are impelled to server side so we require minimum number of signals to pass over the internet. Localization of e-iris and eyelashes removal is the next process of first phase. Once inner and outer boundaries have been localized, the e-iris is extracted alone from the eye image and pushing signals to eyelashes removal [6][7][8][11][12]. In the second phase, e-imaging is converted to normalization. This process is referred as iris strip conversion. Low-pass filtering is employed for enhancing pattern and then feature extraction has been performed.

E-iris features are encrypted using biometric cryptography. Iris cryptosystem is to reduce the system processing time, especially for e-application. It makes a complex crypto key and to generate cipher keys without getting back from complex key generation sequences. The identical iris code is used in both ends to encrypt and decrypt the e-iris features. In order to decrypt e-iris features, the recipient needs an identical copy of the biometric crypto key.

The transmission of e-enrolled iris features over the channel is susceptible to eavesdropping. Hence, a replica of the e-enrolled iris code is needed in the recipient side, which is being employed by the decryption process.

During transmission of e-iris features, if n bits were error, then $O(2^{n-26})$ computational complexity of brute force search was made to an intruder. Thus the retrieving of the original e-iris has been made more complication to the impostors. It provided a high key strength for any cryptography system [18]. This key cannot be stolen or missed and gave more stability to the cryptosystem. These types of bio keys can be produced every time the users want to communicate secretly at non-secure channels.

Once e-iris features are encrypted, then they ready to transmit over a secure media. For that, in our frame work, we transfer control to HTTPS and IP (Internet Protocol) tunneling. These two secure transmission media are fashioned with biometric cryptosystem which ensures secure e-enrolling. Encrypted iris features are stored in a database of banker server based on indexed access code along with e-iris features.

E-Authentication:

The e-authentication has been performed as follows:

- Invoking e-iris predefined phases and store iris features.
- Call control to HTTPS and IP tunneling for transmitting encrypted e-iris features
- Decrypt iris features for authenticating valid e-users matching.
- Check for validation of e-user and satisfaction for providing authentication

An important step of e-authentication is acquiring e-image for providing authentication in diverse environment. It can work both in outdoor and indoor environments with or without any hot spot of lighting intensities. Iris is an internal appendage of eye which is present inside the closed area of the eyelids. For this reason, e-users must provide full cooperation for acquiring their eye images when authentication process is invoked.

Iris extraction is the process to remove unnecessary data such as pupil, eyelashes and other portions from the eye images. They are not required for the Iris feature code generation and iris identification or recognition process.

The first step to extract the iris is inner localization. In this process, we have utilized eight-way symmetry circular method for filtering the inner periphery of the pupil [4][5][17]. Fig. 3 shows the result of inner boundary localization.

Once inner periphery is localized then the extracted image is passed on to outer periphery localization module. This module has four-way symmetry circular method that localizes the outer periphery of the iris [5][6][11[12]. Java source code is implemented for 8-way symmetry implementation. Fig. 4 shows the result of inner and outer boundary localization.

Since eyelid or eyelashes are not a component of iris. They have been isolated from the e-iris images. These isolated partitions are removed by looking the contrasted low-level pixel operation because the iris portion and the eyelashes/eyelids overlap each other and it is a challenging task for the algorithm to make ideal elimination.

Once preprocessing has been completed, e-iris image is now ready for feature extraction. Normalized iris is convoluted by applying Gabor filter banks [5][6][12][13]. Gaussian envelope has a set of frequency variations from $2f$ to $64f$.

The rotation angle ranges from 0 to 135 degrees by incrementing 45 degree each. Once the kernels are computed then extracted normalized e-iris patterns is convoluted by the Gabor filters. Each bank has 24 kernels, and then iris pattern is subdivided into 4 consecutive signals. In this system, 96 features are extracted from a person in order to accomplish the identification process.

Decryption has been called for get back stored e-iris features and compare with authentication e-iris features. Euclidean norm distance measurement discriminator (ENDMD) is employed for discrimination and threshold analysis.

Fig. 3 *Representation of inner periphery localization.*

2. E-enrolling and authentication implementation

E-Enrolling of new user: Interactive camera is enabled along with JII to acquire eye images of e-users. Initially, both left and right eye images are captured for new e-users. Preprocessing has been performed and their iris code features are extracted. The feature is encrypted and stored in the database with indexing.

E-Iris identification: A one-to-one matching of decrypted e-irises is performed with the enrolled decrypted iris. User can opt for either left or right eye for this identification process. Once authentication is provide by the FS server based on the (ENDMD) threshold level and then user is allowed. A primitive call from e-applications has been performed upon to make HTTS and IP tunneling.

Fig. 4 *Representation of outter periphery localization.*

E-iris modification: Already existing enrolled users are allowed to access this option. By using this option, e-users have permitted to authenticate and then allow then reenroll their iris. However, as per research cited [5][6][10][11][12], there is no requirement of reenrolling iris every year or two years once. It is an optional for the e-user and confident about their patterns of iris which is stable throughout his or her life span.

E-iris deletion: E-enrolled users can withdraw their access by e-authentication. Their request is carried over by administration and removed from the e-access application.

Implementation Issues for choosing frame: During the e-enrolment, users are required to take away their eyewear in order to extract non-vulnerability e-iris features. The JII camera interface is employed to acquire the sequence of frames of e-eyes images, among them an appropriate frame is extracted for preprocessing. Choosing an appropriate frame is a complicated process. If JII acquires 25-30fps (Frames per Seconds), then O(n) time complexity is needed for the algorithm, where n is number of frames acquired per second. In addition, space complexity is O(n*(m*p)). That is, a two dimensional frame size is m by p. Once a basic extraction of suitable frame has been performed then the acquired image is passed on to preprocessing and feature extraction.

Implementation Issues E-iris verification: E-iris identification is an important phase of the e-authentication. The frame will make the verdict, whether e-user has been authenticated by the e-application or not. This process has two different approaches such as recognition or identification or verification. During the recognition process, an e-user iris decrypted feature is matched against the remaining decrypted features. This frame work observes threshold changes between the existing desired features and authentication requested features. Once a satisfied threshold level has been closely harmonized between these two feature sets, then the system calls the primitives and allows desired e-user to access e-application of FS, else he/she is rejected from the authentication. However, e-recognition causes more false positives (FP) and false negatives (FN).

An implementation issue behind this process is upholding entire thresholds and propositional searching complexity. The searching complexity of the e-iris sequential recognition is made by comparing each available feature ‘n’ in the database. In the best case, if the desired e-iris is present in the first position, then only one comparison is made. Search complexity is O(1). In the Average case, the desired e-iris is found in the half the way, then O[(n + 1)/2]. But in the worst case analysis, the desired e-iris is present in the last position, then ‘n’ comparisons are made. Computational complexity is O(n + 1). Fig. 8 shows some of the latency time of several phases in frame work.

E-iris recognition can implement using binary searching. The complexity of searching is measured based on where e-iris locates in the database. Observe the recognition that in each recognition call the size of the search locale is reduced by half. The search complexity is $O((\log_2 n)+1)$.

Alternatively, e-identification is a one-to-one matching. Desired e-iris is verified with requested e-iris. Normally minimum FP and FN occur even though e-iris have a huge amount of e-users' iris in the database. Because this process requires an indexing key for example, may be an e-user resident card number to match with the e-enrolled iris exactly. If the threshold is reached, then enable call primitives and allow e-user to access e-application, otherwise, false alarm.

Fig. 5 *Illustration of E-iris enrolling imaging system.*

E-enrolling and authentication have been implemented using java.net.*, java. applet.*, java swing and embedded in applet tag code base parameter. In order to ensure the e- security of the proposed frame work, we have collected 1250 iris images from 1250 diverse subjects [2][11][12][13].

The option of giving left or right eye is also the choice of e-users. Fig. 5 shows e-iris enrolling imaging system based JII applet. It depicts an e-user is enrolling his right side e-eye. JII applet is loaded upon grand all permission given in the java run time security.

E-eye image can capture in 1/2 meter distance. It captures including eye-brows, eye-lashes and eye-lids also. A 26% of e-iris is caught by eyelashes when acquiring e-eye imaging. As a result, e-imaging requires O (n/3.84) more computational complexity. However, it is not an average case.

In the e-iris verification, bury and non-bury classes of iris features are efficiently estranged and they prevent impostors from entering into the secure system. Iris crypto has been further ensures the e-authentication process. In order to do research on findings the variation of external artifacts we have performed certain simulation of the eyelashes and eyelids appeared on the iris portion. Fig. 6 shows the representation of dominance of eyelashes and eyelids of over iris patterns. Study reveals that an average case is 25-35% eyelashes and eyelids appear on the iris patterns while acquiring e-eye images. Due to these artifacts e-iris features are diverged.

Statistical analysis of iris verification: An e-iris feature is described as a one dimensional vector. This is shown in Fig. 9. These 'feature vector' is the computational result of Gabor filter banks convolution operation. The 'feature vector' was determined by the number of decomposition of sub-images and number of Gabor filter banks. ENDMD is employed to discriminate desired and requested e-iris thresholds.

Binominal distribution of e-iris database: A binomial distribution (BD) model is required for statistical analysis of biometric features [5][15][16]. BD model ensures the success probability of e-authentications cases in the sequence of 'n' e-iris independently. It is also called as statistical significance or Bernoulli distribution. The total number of successes in repeated trials from a 'n' population in the e-iris database. BD of iris statistical distances is depicted that each trial has only two exhaustive and mutually exclusive outcomes either success or failure.

As per statistical theory, the ENDMD needs an idealized condition where the e-iris's threshold is aptly suitable for discriminate each individuals from the increasingly population size. Fusion of BD and normal distribution (ND) has been bone to provide the relative frequency density.

In the proposed frame work, threshold value of the decision boundary of ENDMD was set as 0.0-0.35 statistical significance. E-authentication was set as $ENDMD \leq 0.35 \;\; \&\& \;\; ENDMD \geq 0.0$. This statistical threshold was found by the BD and ND.

Java security issues:

In this frame work, java run environment (JRE) JII is invoked when e-users called for e-enrolling. However, due to java version mismatch system prompts message as "Do you want to run this application?" (Fig.7). E-users have to frequently update the recent version of JRE. Even though java gives you three options as Run, Update and cancel. They can choose according to their requirement. Another issue is to modify the policy file in the JRE. It is located at java/ lib/security. Java policy security has a standard security as "java.security.AllPermission". However, this frame work further improves the java security by incorporating grant permission {java.io.FilePermission, path,"read,write"}. It ensures authenticated e-users alone to access the e-apps.

Fig. 6 *Representation of dominance of eyelashes and eyelids over iris patterns.*

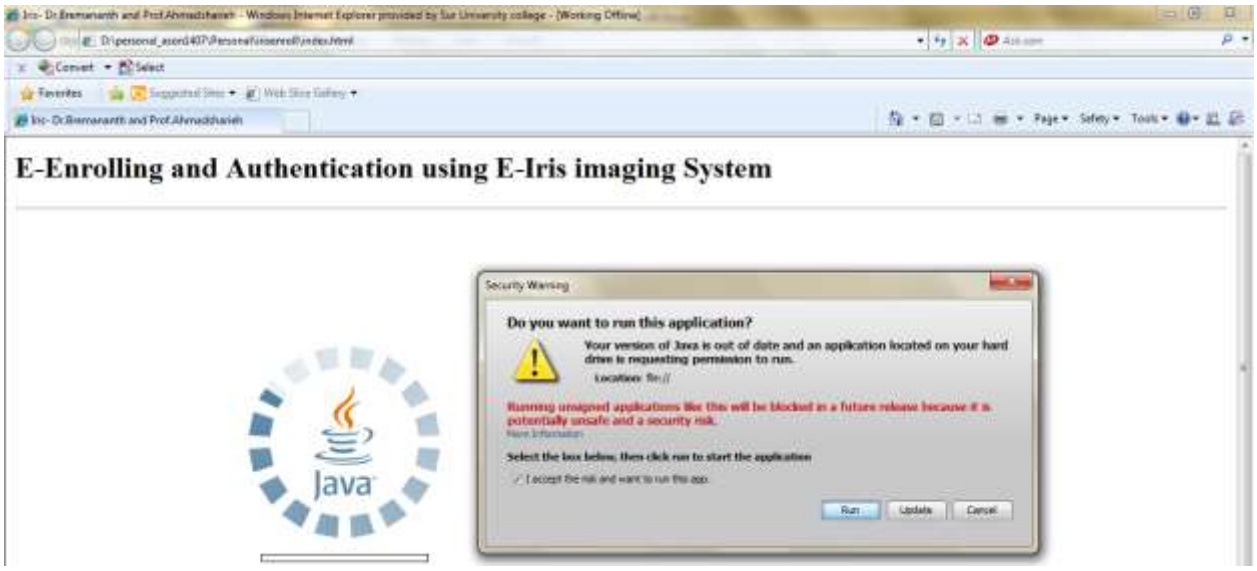


Fig. 7 *Illustrates java security when version mismatch occurs and popup for running permission.*

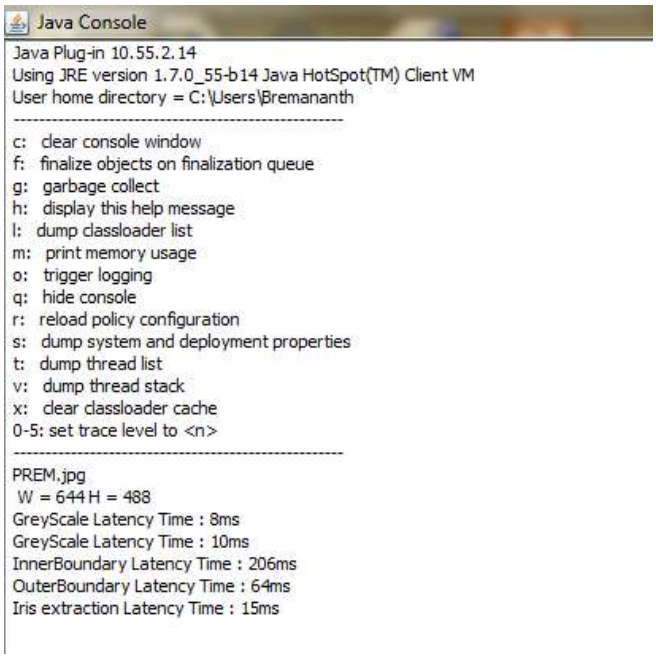


Fig. 8 *Java console for e-user client side virtual machine.*

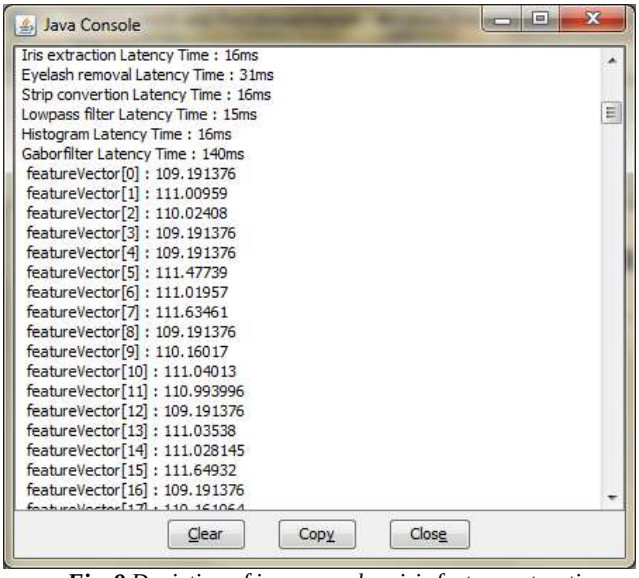


Fig. 9 *Depiction of java console e-iris feature extraction.*

3. Conclusion

In this research work, we have studied the essential security issues in the FS e-apps. We have contributed mainly some solutions to the problem such as e-iris enrolling, e-authentication, and a frame work for e-app secure system. The system is simulated in the platform independent java run environment including JII. It can be incorporated with security algorithm, MD5 e-iris signature and security levels. Furthermore, a frame work of e-iris methodology is aptly suitable for any real-life e-apps such as e-voting, e-employee management system, e-MIS, e-exam, e-passport, e-resident card, e-ticketing and other related applications. This paper reveals a new avenue in e-iris security and its e-apps in diverse areas and especially in FS. In addition, this system can be utilized to authenticate a person in any kind of e-apps. A new approach will be recommended to enhance to sense eyewear in acquired e-images and diminish artifacts occurring in the iris area while capturing.

4. Acknowledgment

Authors would like to thank the Management of Sur University College, Sur, Oman to provide financial assistant to do this research a successful manner.

5. References

[1] Andrew M. Cuomo Benjamin M. Lawsky, "Report on Cyber Security in the Banking Sector", Department of Financial Services, New York state, pp.1-12, May 2014.

[2] Andrew Clark, Tien Tien Tan, "Financial Services sector analysis of PwC's 2014 Global Economic Crime Survey", pp.1-20, Germany, 2014.

[3] Soni R.R., Soni Neena, "An Investigative Study of Banking Cyber Frauds with Special Reference to Private and Public Sector Banks", Research Journal of Management Sciences, vol. 2(7), pp. 22-27, July 2013.

[4] Bremananth R, Chitra A, "New methodology for a person identification system," Springer - S¯adhan¯a, vol. 31, part 3, pp. 259–276, June 2006.

[5] Daugman J, "How iris recognition works," IEEE Trans. Circuits Syst. Video Technol. vol. 14, pp. 21–30, 2004.

[6] A. Picon, O. Ghita, P. Whelan, and P. Iriondo, "Fuzzy spectral and spatial feature integration for classification of nonferrous materials in hyperspectral data," IEEE Trans. Ind. Inform., vol. 5, no. 4, pp. 483–494, Nov. 2009.

[7] A. Kumar, "Computer-vision-based fabric defect detection: A survey," IEEE Trans. Ind. Electron., vol. 55, no. 1, pp. 348–363, 2008.

[8] D. Tsai and J. Luo, "Mean shift-based defect detection in multicrystalline solar wafer surfaces," IEEE Trans. Ind. Inform., vol. 7, no. 1, pp. 125–135, Feb. 2011.

[9] Q. Zhao, D. Zhang, L. Zhang, and N. Luo, "Adaptive fingerprint pore modeling and extraction," Pattern Recogn., vol. 43, no. 8, pp.2833–2844, 2010.

[10] D. Zhang, G. Lu, W. Li, L. Zhang, and N. Luo, "Palmprint recognition using 3-D information," IEEE Trans. Syst., Man, and Cybern., Part C: Appl. Rev., vol. 39, no. 5, pp. 505–519, 2009.

[11] L. Zhang, L. Zhang, D. Zhang, and H. Zhu, "Online finger-knuckleprint verification for personal authentication," Pattern Recog., vol.43, no. 7, pp. 2560–2571, 2010.

[12] Uludag U, Pankanti S, Prabhakar S, Jain A K, "Biometric cryptosystems: Issues and challenges," Proc. IEEE, vol 92, pp. 948–960, 2004.

[13] Chitra A, Bremananth R, "Efficient identification based on human iris patterns," Proc. of Fourth Indian Conf. on Computer Vision, Graphics and Image Processing (ICVGIP 2004), pp. 177–183, 2004.

[14] Bremananth R, "Transformation Invariance and Luster Variability in the Real-Life Acquisition of Biometric Patterns," International Journal of Computer Science and Information Security, vol. 9(11),pp.8-15, 2011.

[15] R. Bremananth, Chitra A, "Rotation Invariant Recognition of Iris," Journal of Systems Science and Engineering, SSI, vol.17(1), pp.69-78, 2008.

[16] Hussein H. Fakhry and Benedict Bernard Cardozo, "Research and Development of an iris based recognition system for identification and secure authentication," Information & Security: An International Journal, vol.19, pp.39-57, 2006.

[17] R. Bremananth, Ahmad Sharieh, "Simulation of Library Security System Using Iris Scanning", MESM'2012, Middle Eastern Simulation and Modeling Conference, December 10-12, 2012, AOU, Muscat, Oman, pp.41-45, ISBN:978-90-77381-75-5, EUROSIS, ETI.

[18] R. Bremananth, Ahmad Sharieh, "Cryptosystem for Computer security using Iris patterns and Hetro correlators", International Journal of Advanced Computer Science and Applications,Vol. 2(11), pp.1-8, 2011.

6. Authors Short Profiles:

Assoc. Prof. Dr. R. Bremananth has received Ph.D. degree in 2008 from Computer Science and Engineering Department, PSG College of Technology, Anna University, Chennai, India. He has completed his Post-doctoral Research Fellowship (PDF) from the School of Electrical and Electronic Engineering, Information Engineering (Div.), Nanyang Technological University (NTU), Singapore, in 2011. Before joining NTU, Singapore, he was a Professor and Head, Department of Computer Science and Application, in India. He has totally 22 years experience in teaching, research and software development at various institutions. Currently, he is an Associate Professor for Information Technology, IST department, Sur University College, Sur, Oman, affiliated to Bond University Australia. He is an associate editor of various International Journals in USA and He is an active reviewer of various IEEE, IET Journals, Transactions and Conferences. His fields of research are Artificial Intelligence, Acoustic imaging, Biometrics, Computer vision, Computer network, Data structures, Human computer interaction, Image processing, Microprocessors, Multimedia, Pattern recognition, Software engineering, and Soft computing.

Dr. Bremananth received the M N Saha Memorial award for the Best Application Oriented paper in the year 2006 by Institute of Electronics and Telecommunication Engineers (IETE). His continuous contribution of research was recognized by Who's who in the world, USA and his biography was published in the year 2006. He is a member of Indian society of Technical Education (ISTE), Advanced Computing Society (ACS), International Association of Computer Science and Information Technology (IACIT) and Institute of Electronics and Telecommunication Engineers (IETE).

Professor Dr. Ahmad Sharieh holds two bachelor degrees: one in Mathematics (1977) and one in Computer Sciences (1983), master degree in Computer Science (1985), High Diploma in Teaching in Higher Education (1987), and PhD in Computer and Information Sciences from Florida State University (1991). He held several academic and administration positions: Assistant Professor in Fort Valley College / USA, Chairman of Computer Science Department at the University of Jordan (UJ), Assistant Dean of Research Deanship at UJ, Chairman of Computer Science Department at Amman Arab University for Graduate Studies, Chairman of Central Tender Committee at UJ, Dean of King Abdullah II School for Information Technology (KASIT) at UJ, and Director of University Development Affairs (e-learning, On-line exams, Staff development, Quality Assurance, Accreditation, Website) at UJ. Currently (since Oct. 2008), he is the Dean of Sur University College.

Prof Sharieh initiated (as Coordinator or member) several academic and training programs: KASIT, Master in Computer Science, Master in Computer Information Systems, High Diploma in Information and Communication Technology in Education, E-government Diploma, Information Technology College at Amran University (Yemen), and E-Business Competence Center at UJ.

Aromatic hydrodecyclization of using catalysts based on molybdenum and tungsten supported on the Remblend of Kaolin.

Mimoun,Hadj, Boukhemkhem, Ali
Université de Boumerdes
mimounhadj@yahoo.fr

Abstract: The study comprises hydrogenating petroleum fractions rich polyaromatic diesel fuel using clay based catalysts. In this connection was used to prepare two Remblend Kaolin types of catalysts. The first is monometallic, consisting of molybdenum and the second is bimetal, consisting of molybdenum and tungsten. The filler used is the average aromatics. The study is based on the change in the content of aromatics as a function of temperature and under constant hydrogen pressure,

Keywords: hydrodecyclization open - cycle, Kaolin, aromatic extract, polyaromatic, catalysts

1. Introduction.

The very stringent specifications are adopted in several countries to minimize the negative harmful exhaust emissions impact. Reducing the sulfur content concentration of the polycyclic aromatic and a cetane number greater become requirements for diesel and fuel oils. The high demand for gas oil refiners requires increased recovery of aromatic fractions from the catalytic cracking process using novel catalysts which provide aromatic hydrogenation followed by selective ring opening of naphthenes.[1].

The présente'étude is structured in three parts. The first is based on the preparation of two catalysts utilisantle Kaolin Remblend. The first is monometallic, consisting of molybdenum Mo / Kaolin, second bimetal is composed of tungsten and molybdenum Mo-W / Kaolin [2,3].

The kaolin used is subjected to physico-chemical analyzes to determine the mineralogical composition and physico-chemical and mechanical properties of the clay.

The second is to develop the petroleum fractions containing high levels of polyaromatic diesel fuel by the methods of déshydrodécyclisation aromatics using a vast catalysts prepared.

The study isbased on the variation of the content of aromatics as a function of temperature under the hydrogen pressure constant.

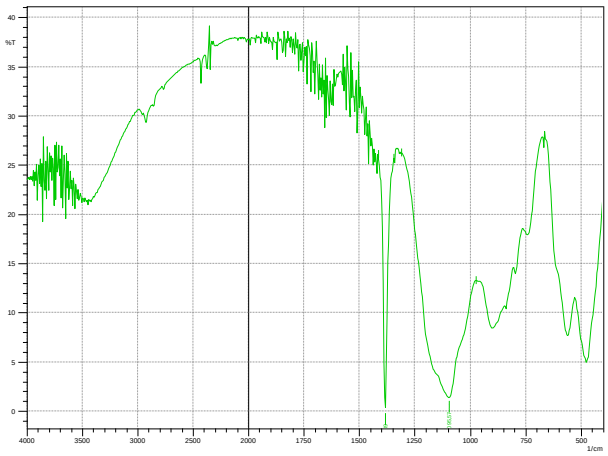
A third part is devoted to the chromatographic analysis of products to develop the conversion and selectivity of catalysts .

2. Experimental

A series of analysis was performed to characterize the natural clay used as carrier for catalysts.

2.1. Infrared spectroscopy Analyse

Figure 1: *Infrared spectrum of natural Kaolin Remblend*



According the IR spectrum gave the following bands are observed:

3400-3500 Cm-1: Broadband attributed to hydroxyl groups OH.

1630-1700 Cm-1: Assigned to the vibration of the water molecule.

752-789 Cm-1: Denotes the elongation of the vibration of Si-O-Al bond.

1095 Cm-1: Denotes the elongation of the Si-O bond.

540 Cm-1: Characterize the elongation of the Al-O-OH bond.

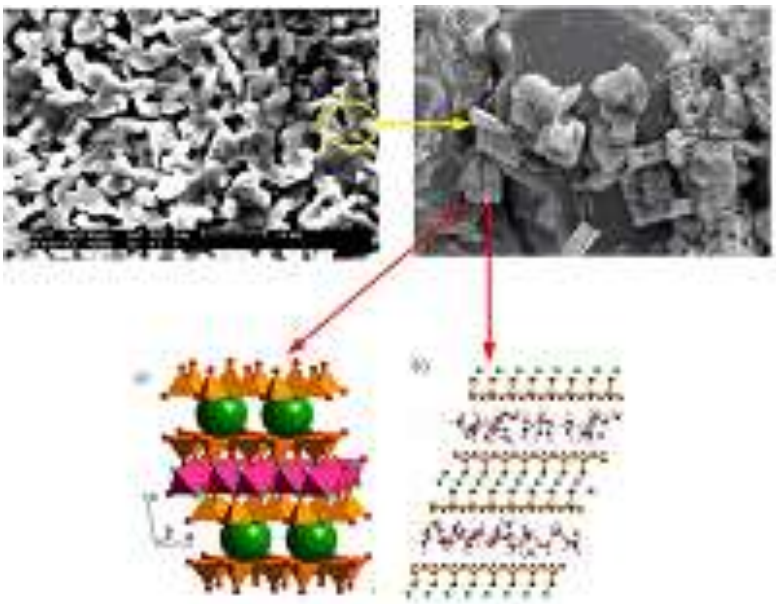
913 Cm-1: Characterize the elongation of the Al-OH bond.

570 Cm-1 characteristic of the Si-O deformation [4] binding

2.2. Mineralogical structure of the kaolinite

Mineralogical analysis was performed of USING SEM brand PHILIPSE FX30. kaolin structure used is shown below in figure 2

Figure 2: *MEB Image of natural kaolin Remblend*



The clay minerals are kaolinites formed by stacking sheets of identical type 1: 1 of structural formula $Si_2A_{l2}O_5$ (OH) $_4$. Each sheet of kaolinite, consists of a SiO_4 tetrahedron layer connected in one plane by their three vertices associated with an octahedral layer, two three octahedral sites are occupied by aluminum atoms. [5]

2. 3. Determination of the chemical composition.

Data analysis by fluorescence X (XRF) is given by the following table 1

Table 1: *Composition chimique du kaolin Remblend.*

Analysed elements	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	PAF
% massic	*48*	*37*	*0.85*	*0.05*	*0.07*	*0.3*	*1.75*	*0.1*	*12.1*

2.4. Determination of cation exchange capacity (CEC)

The cation exchange capacity of a clay is given by the following relation ship:

$$CEC = \frac{V_{mb}}{W_m} \quad (meq/100\,g)$$

Where : V_{mb} is added in ml volume of methyl blue.
W_m is the amount of mud used in the test in g.

According to the image can be calculated if the following is our clay CEC: $CEC_n = \frac{8}{3} = 2\ (meq/100g)$ [6].

Figure 3: *Determination of CEC by metrhylene blue test*

2.5. mineralogical analysis

Table 2: *Mineralogical composition of kaolin Remblend.*

minerals	**% mass**
Kaolinite	83
micaceous material	13
Feldspath	2
Other minerals	2

2.6. particle size analysis

Table 3: *Grain size of kaolin Remblend*

Particles size (µm)	**% Mass**
> 53	0.1
> 8	18
< 2	40

2.7. Physical and Mechanical Properties

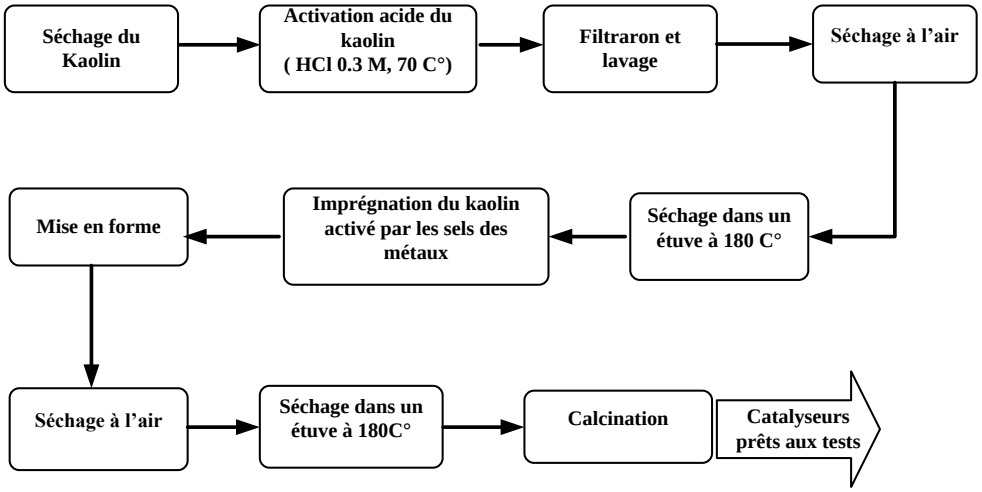
Table 4: *Physical properties of kaolin Remblend.*

Property	**Value**
whiteness (%) at 1180 C° at 1280 C°	82 87
Absorption (% mass) at 1180 C° at 1280 C°	16.5 9.5
withdrawal (%) at 1180 C° at 1280 C°	7 11
Cohesion in thought (dried at 110 C°)	10.9 Kgf/cm^2
Concentration casting	67%
Casting speed	2 mm^2

3. Preparation of Catalysts

We prepared two types supported on kaolin Remblend catalysts:
* The first is a monometallic catalyst containing molybdenum (MoO3 / Kaolin), the percentage of metal is 1%, using as the source of molybdenum ammonium heptamolybdate $(NH_4)_2Mo_7O_{24}.4H_{2O}$ (M=1235.85, Purity = 82 %)
* The second is a bimetallic catalyst consisting of 1% molybdenum and 0.5% of tungsten (MoO_3-WO_3/Kaolin), la source de tungstène est l'acide phosphotengustene $H_7[P(W_2O_7)_6]4H_2O$ (M=2988.77, Purity=98 %) [7, 8, 9]

Figure 4: *Steps in the preparation of catalysts*

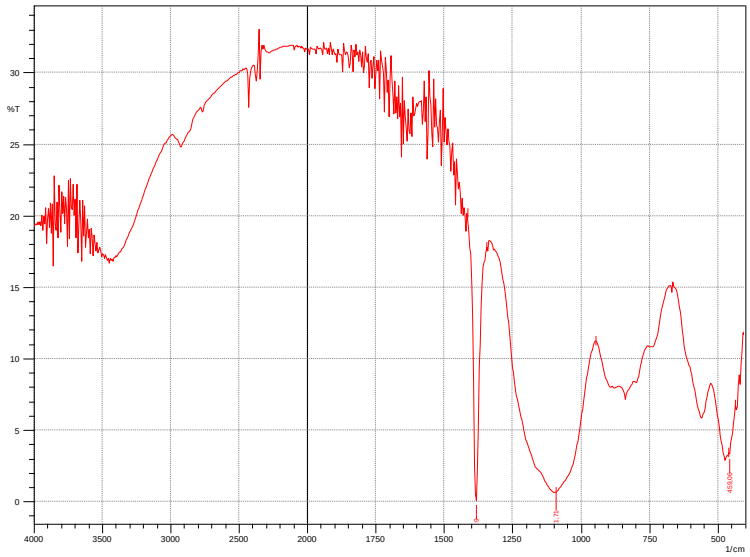


3.1. Characterization of the catalysts used

3.1.1. Analysis by infrared spectroscopy

The catalysts obtained are characterized by infrared spectroscopy, the spectra obtained for the two catalysts are almost the same general shape, the strips are observed:
3400-3500 Cm-1: Broadband attributed to hydroxyl groups OH.
1630-1700 Cm-1: Assigned to the vibration of the water molecule.
752-789-803 Cm-1: Denotes the elongation of the vibration of Si-O-Al bond.
1095-1171 Cm-1: Denotes the elongation of the Si-O bond.
500-450 Cm-1: Denotes bands metal oxides.
913 Cm-1: Characterize the elongation of the Al-OH bond
570 Cm-1 characteristic of the Si-O deformation [10] binding.

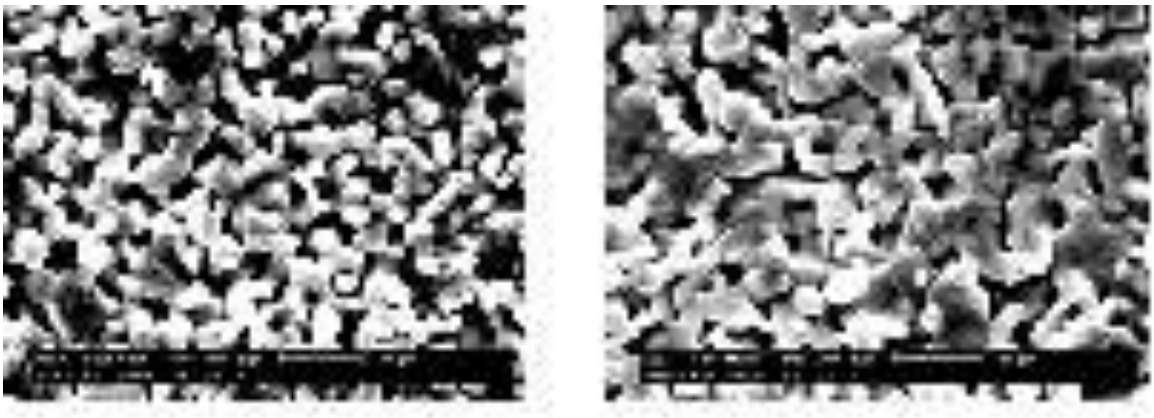
Figure 5: *Infra red spectrum of the prepared catalysts*



3.1.2. Analysis by electron microscopy (SEM)

Images provided by the SEM Philips XL30 guy with a magnification of × 2000 are illustrated in the figures below:

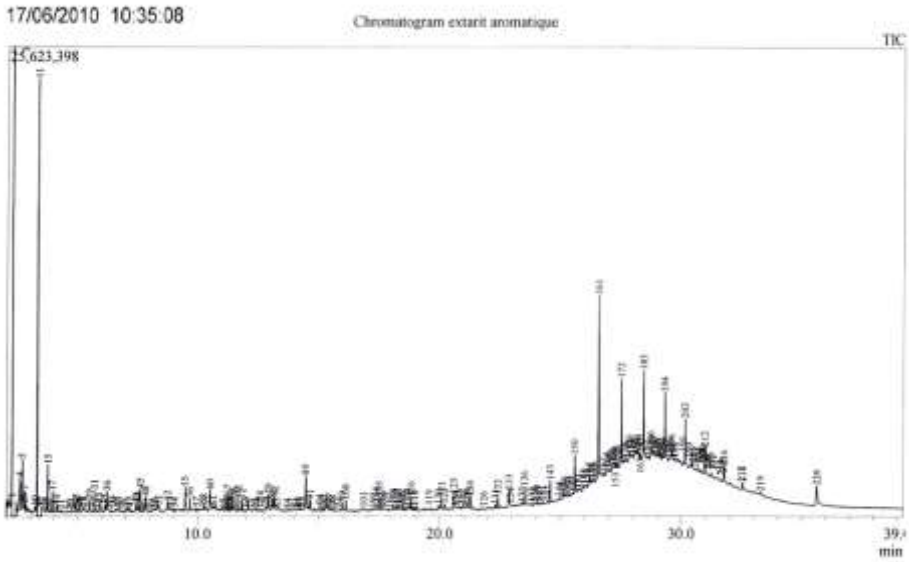
Figure 6: *the SEM images Given by the prepared catalysts*



3.2. Load analysis used

The filler used is the average aromatic, resulting in the extraction of aromatic oils contained in the basic method extracts. We study the elemental composition of paraffins, olefins, naphthenes and aromatics, why was performed chromatographic analysis by gas chromatography (GC) chromatograph is equipped with a detector with mass spectroscopy (Shimadzu QP2010). We detected 220 peaks, we are only interested in: P, O, N, A. The chromatogram is given by the following figure:

Figure 7: *Chromatogram of the filler used*



3.3. The operating conditions

The selected operating conditions (temperature, space velocity and contact time and hydrogen pressure were inspired by the literature:
* Temperature: Both catalysts were tested at 450 ° 470.490 and 540C.
* A PPH 2h-1.
* Hydrogen pressure = 6 bar [11,12,13]

3.4. Obtained results

The results are illustrated in the following two tables:

Table 5: *Products obtained by the catalyst MoO_3/ Kaolin*

Temperature (C°) / ***Family***	***Average aromatic extract***	***450***	***470***	***490***	***540***
Monoaromatics	10.81	9.88	9.76	11.90	24.98
Polyaromatics	53	12.33	11.26	12.13	34.58
Naphtenes	6.70	20.96	19.76	18.27	12.41
Olefines	3.30	12.36	13.56	14.87	12.38
Paraffines 7 < n< 20	6.42	24.65	29.22	28.62	8.34
Paraffines n > 20	19.63	19.78	16.84	14.52	7.28
sulfur	0.24	0.11	0.04	-	-
Coke	-	0.09	0.17	0.25	1.23
Cracking products	-	-	1	4	8

Table 6: *Obtained Products by the catalysts MoO_3-WO_3/ Kaolin*

Temperature en (C°) / ***Famille***	***Average aromatic extract***	***450***	***470***	***490***	***540***
Monoaromatics	10.81	9.46	9.78	10.39	22.67
Polyaromatics	53	11.45	9.29	10.74	32.67
Naphtenes	6.70	23.09	23.49	22.67	14.42
Olefines	3.30	9.79	11.62	11.54	9.60
Paraffines 7 < n< 20	6.42	27.24	29.19	30.35	11.55
Paraffines n > 20	19.63	18.88	16.62	14.29	9.49
Sulfur	0.24	0.12	0.02	0.01	0.00
Coke	-	0.1	0.15	0.22	1.1
Cracking products	-	-	0.4	2	6.5

3. Conclusion

The raw material used is characterized by various analytical methods including the following conclusions were reached:

- Infrared spectroscopy showed the various bonds present in the clay used.
- The picture given by the scanning electron microscope has confirmed the layered structure of Kaolin.
- The brightness is from 82 to 1180 ° C and from 87 to 1280 ° C, these values confirm that Remblend Kaolin contains little metal oxides (Fe_2O_3, MgO and TiO) is a fine clay.
- The purity of the clay is confirmed by X-ray fluorescence, which gave us the exact chemical composition.
- According to the mineralogical analysis of Kaolin we see that it consists of 83% kaolinite. The percentage of quartz, mica and feldspar materials is low.
- Calculates the CEC shown in the clay structure contains exchangeable cations.
- Particle size analysis shows the homogeneity of the raw material used.

The above analysis confirms the good quality da clay used.

Catalytic testing of reactions hydrodecyclization aromatic contained in the aromatic extract medium led to the following results:

- The Bimetallic catalyst (MoO_3-WO_3 / Kaolin) is more active than monometallic.
- Under a pressure of 6 bar hydrogen increases the temperature leads to the formation of products derived from aromatic hydrocyclisation, but beyond the temperature of 490 ° C are the cracking reaction predominate.
- Both catalysts show good activity vis-à-vis the removal of mercaptans.
- The deposit of coke on the two catalysts becomes increasingly significant with increasing temperature, this coke poisons the catalysts.

It appears from these results that:

- The prepared catalysts are effective for aromatics hydrodecyclization process contained in the aromatic extract medium.
- It is possible to develop highly aromatic fractions.
- The products of hydrodecyclization have good cetane number.
- Catalyst regeneration is required to maintain a good activity.
- It is necessary to increase the hydrogen pressure to avoid catalyst deactivation by coke deposition.

4. References

[1] M.A.Arribas and al, Hydrogenation and ring opening of Tetralin over bifunctional catalysts based on the new ITQ-21 zeolite, Applied Catalysis A:General, volume 273 (2004) 277-286.

[2] M.E.Gyftopoulou and al, pillared clays as catalysts for hydrocracking of heavy liquide fuels, Applied Catalysis A: General, 282 (2005) 205-214.

[3] Wei-Qiao Liu and al, Saturation of aromatics and aromatization of C3 and C4hydrocarbons over metals loaded pillared clay catalysts, Ctalysis Today 51 (1999) 135-140.

[4] Hui Feng and al, Effect of Calcination Temperature of Kaolin Microspheres on the In situ Synthesis of ZSM-5, Catalysis Letters, 129 (2009) 72.

[5] Christelle Bich, Contribution à l'étude de l'activation thermique du kaolin : évolution de la structure cristallographique et activité pouzzolanique, Institut national des sciences appliquées de Lyon (2005).

[6] AVA S.p.A, Engineering Field Manual, Version 1, Rome, 2004, pp: 12,13.

[7] S.Albertazzi and al, Hydrogenation of naphthalene on noble-metal-containing mesoporous MCM-41 aluminosilicates, Journal of Molecular Catalysis A: Chemical, 200, (2003) 261-270.

[8] Mélanie jacquin and al, Cetane improvement of diesel with a novel bimetalic catalyst, Jounal of Catalysis, 228 (2004) 447-459.

[9] Malee Santikunaporn and al, Ring contraction and selective ring opening of naphtenic molecules for octane number improvement, Applied Catalysis A:General, Volume 325 (2007) 175-187.

[10] Hui Feng and Al, Effect of Calcination Temperature of Kaolin Microspheres on the In situ Synthesis of ZSM-5, Cat Lett, 129 (2009) 71-78.

[11] Xiangchun Meng and al, Tailoring the pore size of zeolite Y as the support of diesel aromatic saturation catalyst, J Porous Mater (2006) 365-371.

[12] Michael C.Oballa and al, Aromatic saturation and ring opening process, US20070062848 A1 (2007) 1-8.

[13] Baird Jr and al, Naphtalene ring opening over VIII metal catalysts, US6623625 B2 , (2003) 1-9.

CHAIN-REDS Application Use Cases on Data Management

S. Al-Agtash[a,b], R. Barbera[c,d], B. Becker[e], C. Carrubba[d], S. Chattopadhyay[f], A. Dupont[g].
G. Inserra[d], C. Kanellopoulos[h], K. Koumantaros[h], R. Mayo-García[i], L. Núñez[j], O. Prnjat[h],
R. Ricceri[d], M. Rodriguez-Pascual[i], A. Rubio-Montero[i], F. Ruggieri[k,l], Y. Tormanb[b], W. Wu[m]
(On behalf of the CHAIN-REDS project)

[a] *Department of Computer Engineering of the German Jordanian University, P.O. Box 921951 – Amman 11192 – Jordan*

[b] *Arab States Research and Education Network, P.O. Box: 921100 – Amman 11192 – Jordan*
alagtash@ASRENOrg.net

[c] *Department of Physics and Astronomy of the University of Catania, Viale A. Doria, 6 – 95125 Catania – Italy*

[d] *Italian National Institute of Nuclear Physics, Division of Catania, Via S. Sofia, 64 – 95123 Catania – Italy*
{roberto.barbera, carla.carrubba, giuseppina.inserra, rita.ricceri}@ct.infn.it

[e] *Meraka Institute, Meiring Naudé Road – a Pretoria, 000 – South Africa*
bbecker@csir.co.za

[f] *Centre for Development of Advanced Computing, Ganesh Khind Pune – 411 007 Maharashtra – India*
subratac@cdac.in

[g] *Sigma Orionis, Buropolis 1, 1240 route des dolines – 06560 Valbonne Sophia Antipolis – France*
anthony.dupont@sigma-orionis.com

[h] *Greek Research and Technology Network, 56, Mesogion Av. – 11527 Athens – Greece*
{skanct, kkoum, oprnjat}@admin.grnet.gr

[i] *Centro de Investigaciones Energéticas Medioambientales y Tecnológicas, Av. Complutense, 40 – 28040 Madrid – Spain*
{rafael.mayo, manuel.rodriguez, antonio.rubio}@ciemat.es

[j] *Escuela de Física, Universidad Industrial de Santander, Cra 27 calle 9 – Bucaramanga – Colombia*
lnunez@uis.edu.co

[k] *Consortium GARR, Via dei Tizii 6 – Rome, 00185 – Italy*

[l] *Italian National Institute of Nuclear Physics, Division of Roma Tre, Via della Vasca Navale 84 – 00146 Rome – Italy*
federico.ruggieri@roma3.infn.it

[m] *Institute of High Energy Physics, Chinese Academy of Sciences, 19B Yuquan Lu, Shijingshan– Beijing 100049 – China*
wuwj@ihep.ac.cn

Abstract: CHAIN-REDS started on December 2012 and focuses on promoting and supporting technological and scientific collaboration across different e-Infrastructures established and operated in various continents. After two years of work, specific results on data handling (use, management, exploitation, interoperability) are presented with a special focus on Arab use cases.

1. Introduction

CHAIN-REDS started on Dec, 1st 2012 and focuses on promoting and supporting technological and scientific collaboration across different e-Infrastructures established and operated in various continents. Thus, it aims to facilitate these e-Infrastructures uptake and their final use by established and emerging Virtual Research Communities (VRCs), but also by single researchers.

To do so, it is essential to promote instruments and practices that can facilitate their inclusion in the community of users, such as the use of standards. Then, to build on the best practices currently adopted in Europe and other continents and to promote and facilitate interoperability among different e-Infrastructures is a must. In this way, it has been an asset to gradually work out a step-by-step strategy for developing the European data infrastructure in the regions targeted by CHAIN-REDS, among them the North of Africa and the Middle East. Addressing basic issues such as data persistency, accessibility and interoperability has been the first general goal.

CHAIN-REDS, in accordance with several European strategies, has focused on including low-level services, exchanging in data infrastructures and supporting preservation and data exploitation services, as well as activities aimed at interoperability and data access federation and openness.

The first step has been to identify such best practices and approach the main stakeholders of regional e-Infrastructures and data provisioning/use in order to propose and even define a path towards a global e-Infrastructure ecosystem that will allow VRCs, research groups and even single researchers to access and efficiently use worldwide distributed resources (i.e. computing, storage, data, services, tools, applications).

As a main issue, the efficient access, use and further analysis of data has emerged. The number of Data Repositories (DRs) and Open Access Document Repositories (OADRs) and the volume of data they store have largely increased in the latest years. As a consequence, if CHAIN-REDS aims to allow VRCs, research groups and single researchers to efficiently use worldwide distributed resources, it is needed that the data they are employing will be interoperable as well. Otherwise, advances made on middleware interoperability will be meaningless since the computational resources will not be properly exploited.

CHAIN, the precursor of CHAIN-REDS, already promoted interoperability as a main objective. A worldwide demo was shown and demonstrated in September 2012 and the project launched several initiatives, which were a step beyond in facilitating the access to information coming from different regions. Thus, the Knowledge Base [1] provided information about the deployment of e-Infrastructure related topics per country and even about specific Distributed Computing Infrastructures (DCIs) by means of a Site or a Table view. All these concepts conducted to a validation model for VRCs that was successfully tested by the end of CHAIN by counting on the aforementioned worldwide demo and the roadmap of services requested from the VRCs to the DCIs.

During the CHAIN-REDS lifetime, the project has been working on extending the CHAIN Knowledge Base with information related to data infrastructure. To do so, it has collected both issues and best practices and has surveyed the involved regions in order to discover data repositories that could be of interest for VRCs. The reason for that is to promote data sharing across different e-Infrastructures and continents, widening the scope of the existing CHAIN Knowledge Base to Data Infrastructures and to finally provide proof-of principle use-cases for Data sharing across the continents by the end of CHAIN-REDS.

This paper documents the actions that have been performed to the moment, that is, the results of making available and useful Data Infrastructures and Data repositories worldwide and provide such capabilities in a complete research cycle, i.e. cover from the first bibliographic search to the final results dissemination by using the (raw) data of interest in a scientific code seamlessly executed on DCIs.

2. Work Plan

The CHAIN-REDS work plan addresses the following objectives:

Obj1. Extend the CHAIN Knowledge Base (KB) with Data Infrastructure. During the CHAIN project lifetime, the consortium made a big effort in implementing a KB that contained detailed information about the different Grid initiatives around the world. This information could be displayed in the CHAIN webpage (see [1]) in a three-fold basis: Country, DCI Site and DCI Table views. In the former, the user could search on a worldwide map his country of interest and click on it, so information about his domestic Grid status was displayed. In the DCIs views, information about the Distributed Computing Infrastructures per site geographically displayed on a map or per country showed in a table could be retrieved. For CHAIN-REDS, the KB is being enhanced with information related to Data infrastructure.

Obj2. Support the study of data infrastructures for a few VRCs. Use cases aforementioned should count on a community of users (VRCs) who would test and give feedback about the solutions proposed by CHAIN-REDS related to interoperability aspects of data infrastructures. In this sense, the project will support these VRCs in the process of learning (if any), implementation (if any) and final validation.

Obj3. Promote trust building towards open scientific data infrastructures across the world regions. Trust building is of outmost importance for users from different groups to be able to access data previously stored by different researchers in different world regions relying not only on their accuracy, but also on their computational format i.e. these users are retrieving the information they are looking for.

Obj4. Study the opportunities of data sharing across different e-Infrastructures and continents. For achieving such a goal, it is necessary to survey different sources of information in order to look for synergies that could be exploited: groups of researchers (VRCs) who could make use of big amount of data in the countries belonging to the

continents targeted by CHAIN-REDS; DCIs who could report on the users that usually transfer big amount of data too; and, on-going well-established data initiatives.

Obj5. Provide proof-of principle use-cases for data sharing across the continents. Select among the identified candidates those who present promising opportunities for data sharing in terms of standards and good practises selected by CHAIN-REDS.

To achieve Objective 5, several actions have been carried out:

Action1. Analyse which standards are most used and, as a consequence, extended worldwide and accordingly propose best-practices to the communities to be approached (i.e. achieve Obj3);

Action2. Define in what terms the CHAIN-REDS KB should be improved in order to firstly collect and lately display, in a dynamic way, information related to data infrastructures (Obj1);

Action3. Analyse which repositories and what related scientific fields are of interest to CHAIN-REDS according to Action1 and Action2 (Obj2 & Obj4);

Action4. Survey the different countries and DCIs of interest to CHAIN-REDS and the well-established data-related initiatives in order to get their feedback about their usage of the identified standards and the computational platforms that are being utilised (Action2) and about the groups that are profiting from a huge employment of data and belong to the identified scientific fields (Action3). In addition, propose to the latter the CHAIN-REDS support for adopting the proposed standards (Obj2-Obj4);

Action5. Analyse the results of the survey (Action4) and focus the project efforts on two or three scientific communities in order to efficiently perform data sharing in terms of some standards and good practises (Obj5). This action have counted on the support from CHAIN-REDS in order to implement or adopt some standards if necessary, the collaboration of the identified communities by means of MoUs which would rule the scientific liaison and the support of DCIs for making the real demonstration of data interoperability.

3. Standards Adopted and their Adoption in the Project Tools

In order to work on any action or goal, the first key point is the definition of the way in which it is expected to be achieved. In CHAIN-REDS, this meant to select the standards that would be fostered by CHAIN-REDS and, hopefully, adopted by the collaborative VRCs (if necessary).

At the same time, it is of outmost importance that such standards have a wide presence worldwide because of the intercontinental scope of CHAIN-REDS.

Thus, after a deep analysis on the best practices that on-going data initiatives were carrying out, the following standards were selected by the project for pursuing trust building:

Std1. OAI-PMH [3] for metadata retrieval.

Std2. Dublin Core [4] as metadata schema.

Std3. SPARQL [5] for semantic web search.

Std4. XML [6] as potential standard for the interchange of data represented as a set of tables.

Std5. Persistent Identifiers (PID) [7] as a tool to know where and how data and metadata are stored, which is of importance for retrieving the required data successfully. Strictly talking, PID is not a standard yet, but it is becoming the de facto tool for uniquely identify any kind of documental resources.

With this selection in mind, a work plan for improving the CHAIN-REDS KB by adding new functionalities was also planned. As a result, the following steps have been achieved:

Step1. Integration of the KLIOS [8] services inside the KB in order to extend its functionalities. Knowledge linking and sharing in research domains (KLIOS) is a project for developing small research projects and implement them in real-life use cases related to data sharing by means of metadata harvesting.

Step2. Dynamically include in the KB Data Repositories (DRs) and Open Access Documents Repositories (OADRs) worldwide by using the already defined standards. The information related to these repositories should be presented to the user in the same way as the already available DCIs one.

Step3. Take this integration as a proof-of-principle for demonstrating the work carried out. Repositories containing documents (articles, proceedings, books, etc.) were selected in principle for testing and depurating the KB functionalities with the aim of improving its characteristics to other fields and data (see items below).

Step4. Provide the KB with the following capabilities, so further extraction and exploitation of raw data by any user could be performed: semantic web enrichment; semantic search engine; and, a tool for extracting the data associated to the repositories.

Step5. Start working with some specific communities on a strategy for demonstrating data trust building, i.e. the access by a user of data already stored in order to extract them and employ them as input in a scientific application for reproducing and/or extending the results of a given research. The new data and, may be, the new paper will be lately stored on the Data Infrastructure and will be easily found by the people belonging to the same domain (see DART challenge below).

New tools have been provided on the CHAIN-REDS website that are of interest to Data Infrastructures and User Communities. They actually are the backbone that is being used by the DART challenge to achieve data trust building and are the basis for several of the use cases provided by the project. These tools based on the previous mentioned standards are:

Tool1. The Knowledge Base is one of the largest existing e-Infrastructure-related digital information systems. It currently contains information, gathered both from dedicated surveys and other web and documental sources, for more than half of the countries in the world. As of today, the KB contains about 2,500 OADRs and 600 DRs. The total number of resources that are indirectly included in the KB is well above 30 million.

Tool2. The CHAIN-REDS Semantic Search Engine (SSE), which semantically enriches the OADRs and DRs gathered in the KB for relating linked data. The multi-layered architecture of this engine provides the results of a given query displayed on the webpage and ranked according to the Ranking Web of Repositories. Visitors can also access the detailed view of the resource and its reference in Google Scholar, access the document specific link and, if existing, the corresponding dataset, and select one or more of the resources found and get a graphic view of the semantic connections among Authors, Subjects and Publishers. Thus, if new links appear, users can infer new relations among resources, thus discovering new knowledge.

Tool3. The Science Gateway, which is a friendly front-end that allows users to submit jobs seamlessly and unattendedly to be run on Grid, Cloud and HPC infrastructure independently of the middleware they were using. This Science Gateway can be accessed with the user's Identity Federation credentials.

On September 2013, and also as part of EGI Technical Forum, the demo 'Managing and using interoperable DCIs through a standard-based Science Gateway' was successfully performed. It was planned to both demonstrate interoperability (by allowing a scientist to seamlessly run applications on HPC machines, Grids and Clouds) and interoperation (by allowing a cloud-tenant of a real or virtual organisation to seamlessly and easily manage Cloud resources pledged by providers owning/operating infrastructures based on different middleware stacks). Again, and logging into the user-friendly CHAIN-REDS Science Gateway using his/her federated credentials, the user could select an application from a menu and transparently execute it on HPC machines, Grids and Clouds. It is also worth mentioning that the fractions of executions on the three different platforms could be adjusted to simulate the need to "boost" the resources in case of temporary peaks of activity.

4. The Data Accessibility, Reproducibility and Trustworthiness Challenge

The Data Accessibility, Reproducibility and Trustworthiness (DART) Challenge is a methodology that follows the common research workflow. In this scenario, the datasets are found by means of either the CHAIN-REDS KB or the SSE, the applications run via the CHAIN-REDS SG (accessible through an Identity Federation) or the data can be both identified by PIDs and assigned to unique PIDs. The user can then access the data and the corresponding application in order to either reproduce and extend the results of a given study or start a new investigation. The new data (and the new paper if any) are stored on the Data Infrastructure and can be easily found by the people belonging to the same domain making possible to start the cycle again. The requirements that are needed are related to intellectual properties issues and unique identifiers referring to papers, data and applications.

First tests of DART were done with a portlet that makes use of a chemical physics code that obtains molar absorption coefficients from molecular gaseous cross sections (Molon [9]). Such portlet can upload the input file in a three-fold basis: from the local computer where the user is working, introducing the dataset assigned PID, or directly introducing the associated web address of the dataset. The latter two input formats can be obtained from a search on the CHAIN-REDS KB and/or SSE. Then, the user has to simply click on the "Run" bottom of the portlet webpage to start the calculation. Once this will be ended, the user can retrieve the final results and, if desired, assign a PID, so the cycle can be restarted again by any other user who would search for them. For the sake of completion, Molon can use cross sections datasets from the MPI-Mainz UV/VIS Spectral Atlas of Gaseous Molecules of Atmospheric Interest [10].

At this point, it is worth mentioning that the PID can simply assign a permanent reference to a digital object or include also some additional parameters required by the user. At the same time, it can identify a simple raw data or a whole experiment (input and output data, application used).

A demo of the DART workflow has been shown in the EGI CF 2014 in May 2014 in Helsinki. In addition, CHAIN-REDS has recorded two videos of this demo, which are available at the CHAIN-REDS webpage and the project YouTube channel [11].

5. CHAIN-REDS Application Related Use Cases

A number of proposed use cases have been analysed and considered and supported by the project. All of the use cases make use of the e-Infrastructure services promoted by CHAIN-REDS in the different regions, but they cover different and complementary aspects of users' characteristics.

Of special interest in the Arab region can be the ABINIT use case. Due the significant development of the *ab initio* calculations especially the Density Functional Theory (DFT) in the fields of quantum chemistry and the physics of materials, the calculations in those areas become vital. Therefore the idea of introducing a powerful code such as ABINIT [12] within the Grid computing paradigm comes to ease the task of researchers. To do so, a team of ABINIT users attended the CHAIN-REDS Science Gateway porting school held in Catania in June 2014 and ported to the Grid both sequential and MPI ABINIT versions. There is a strong group of users in Algeria who are also training new scientist in the field. The aforementioned versions have been installed in 6 European and Arab sites and the required portlet for job submission has been implemented; such a work will be extended to Latin America in the near future. The portlet has been integrated in the CHAIN-REDS Science Gateway [13] and in the Algerian one [14].

Also in the Arab region it is worth mentioning the CMSquares usage, which looks for Magic Squares[1]. The goal of this application is to generate all natural magic squares of order 6 with predefined restrictions, like having the four corner property or being semi pan-diagonal magic squares. This will reduce the needed time for computations. This kind of calculation needs a long time. So, the calculation is split into several program runs. Additionally, it uses the symmetries (from mathematical point of view) to reduce the run time. The calculated number will be later multiplied with 16. A huge amount of computing resources related to the CMSquares code are being exploited in Jordan via the CHAIN-REDS Science Gateway of this code [15].

In the rest of the world, several use cases are being promoted by CHAIN-REDS as well.

The Latin America Giant Observatory (LAGO - first known as Large Aperture Gamma Ray Observatory) [16] project is a recent collaboration that counts on Water Cherenkov Detectors in 9 Latin American countries, more than 80 Latin American researchers and a close collaboration with European teams such as IN2P3 in France and INFN in Italy. LAGO use-case success story is based on the DART challenge. The consortium maintains a repository of astrophysics interest that is based on DSpace and uses the Corsika code [17] to study the astroparticle clusters. The LAGO repository has been integrated in the CHAIN-REDS Knowledge Base and the Semantic Search Engine. Also, LAGO is currently analysing with the project which is the best strategy for assigning PIDs to the current datasets and to the new data produced as a result of the Corsika executions via the project Science Gateway [13]. LAGO will address three different phenomena thanks to the CHAIN-REDS DART workflow.

The African Population and Health Research Centre (APHRC) [18] undertakes research in a wide range of topics related to societal health and well-being. APHRC runs around 60 projects, publishes around 60 papers, and trains more than 150 fellows per year. To do so, it counts on 18 donors and 51 partners. This use-case is mainly devoted to assign Persistent IDentifiers (PIDs) to the wide plethora of datasets that APHRC manages and curates. This is of utmost importance due to these datasets are widely used by almost every country in Africa in order to improve societal health and well-being. APHRC and CHAIN-REDS have firstly identified which repositories must be catered for and defined a road-map for making this assignment. The PIDs are being assigned to an entire data set at the top-level. The software being used to document the data is Nesstar [19].

Knowing the protein structures is essential for a complete understanding of life processes at the molecular level. Threading is the leading method for protein structure prediction, and it is exceedingly time-consuming. The TreeThreader code [20] uses a new practical threading program, which can take pairwise interaction into consideration. TreeThreader can run on a Linux platform and on a volunteer computing e-Infrastructure using the CAS@home BOINC client and consuming around

[1] A magic square is a matrix, where the sum of the entries in all rows, columns and both main diagonals is the same.

6 million of CPU hours a year. The code is already available to the desktop computing community, and is now made available on a full-blown e-Infrastructure: virtual machines launched from physical servers belonging to the China ROC and managed with OpenStack. For making as easy as possible the use of the new pool of computing resources (BOINC and cloud) to scientist, all TreeThreader jobs can be submitted both within China and Europe.

Researchers are trying to observe molecular activity of various bio-molecules using Molecular dynamics simulation approach. GROMACS software package [21] is used for molecular dynamics simulation. This kind of studies presents a huge computational demand. That is the reason why GROMACS version to be used in this use-case success story is v4.6.5 due to its full-blown MPI capabilities. Fourteen European, Arab and Indian Grid sites have already been enabled with GROMACS version with two flavours: both an installation package and a Science Gateway portlet. In addition, new services related to eTokenServer, GridEngine and wiki pages have been created as well.

6. Conclusions

The CHAIN-REDS project promotes and supports technological and scientific collaboration across different e-Infrastructures established and operated in various continents. Thus, it aims to facilitate these e-Infrastructures uptake and their final use by established and emerging Virtual Research Communities (VRCs), but also by single researchers.

To do so, instruments and practices that can facilitate their inclusion in the community of users have been promoted and several standards have been adopted. Based on them, several useful tools have been implemented such as the Knowledge Base, the Semantic Search Engine and the Science Gateway.

CHAIN-REDS has been working on extending the CHAIN Knowledge Base with information related to data infrastructure. To do so, it has collected both issues and best practices and has surveyed the involved regions in order to discover data repositories that could be of interest for VRCs. Currently, more than 30 million of documents can be semantically searched and accessed through the Knowledge Base.

The project is also supporting and promoting several application use cases in the regions of interest. Among them, the ABINIT and CMSquares use cases being developed in the Arab region are of special interest.

Acknowledgements

This work has been partially funded by the European Commission Seventh Framework Programme project “Co-ordination & Harmonisation of Advanced e-INfrastructures for Research and Education Data Sharing” (CHAIN-REDS, Grant agreement 306819).

References

[1] The CHAIN-REDS Knowledge Base, http://www.chain-project.eu/knowledge-base

[2] The CHAIN-REDS KoM, http://agenda.ct.infn.it/conferenceDisplay.py?confId=866

[3] OAI-PMH, http://www.openarchives.org/pmh/

[4] Dublin Core, http://dublincore.org/

[5] SPARQL, http://www.w3.org/2001/sw/wiki/SPARQL

[6] XML, http://www.w3.org/XML/

[7] PID, http://www.pidconsortium.eu/

[8] KLIOS, http://klios.ct.infn.it

[9] Molon, https://science-gateway.chain-project.eu/molon

[10] The MPI-Mainz UV/VIS Spectral Atlas, http://satellite.mpic.de/spectral_atlas

[11]The CHAIN-REDS YouTube channel, https://www.youtube.com/channel/UC1D-VJ03Ok7OW-MA_MuoNbQ

[12] ABINIT, http://www.abinit.org/

[13] The CHAIN-REDS Science Gateway, https://science-gateway.chain-project.eu/home

[14] Algerian Science gateway, http://sgw.grid.arn.dz/

[15] CMSquares, https://science-gateway.chain-project.eu/cmsquares

[16] LAGO, http://labdpr.cab.cnea.gov.ar/lago/colab.php

[17] Corsika, https://web.ikp.kit.edu/corsika/index.html

[18] APHRC, http://aphrc.org/

[19] Nesstar, www.nesstar.com

[20] TreeThreader, http://casathome.ihep.ac.cn/about_scthread.php

[21] GROMACS, http://www.gromacs.org/

Comprehensive Distance-Flexible Learning through the Latest in Collaboration and Virtualization

Prof. Dr. Karim Zerhouni[(1)], Nathan Wilder[(2)], Aizharkin Burkanova[(3)], Altynai Maganbetova[(4)]
[(1)]*CIO, American University of Central Asia, Bishkek, Kyrgyzstan*
zerhouni_k@mail.auca.kg, kzerhouni@ieee.org
[(2)]*Special Assistant – CIO Office, wilder_n@mail.auca.kg*
[(3)]*Special Assistant – CIO Office, burkanova_a@mail.auca.kg*
[(4)]*Special Assistant – CIO Office, maganbetova_a@mail.auca.kg*
www.auca.kg

Abstract: Colleges and universities need new tools to enrich coursework, enhance flexibility, and attract the best students and faculty. A virtual classroom distance learning solution supported by a BYOD policy enforced campus wide, lets institutions of higher education reach students anywhere, anytime, realizing a better return on technology investments by blending fully interactive and recordable audio, video, and Web conferencing capabilities on any capable device owned by the recipient. With this design, and using these tools, colleges and universities can extend the walls of their classrooms in both space and time, and bring the rest of the world to their campuses.

Keywords: e-learning, virtual classroom, distance education, BYOD, secure access, eduroam, connectivity

1. Introduction

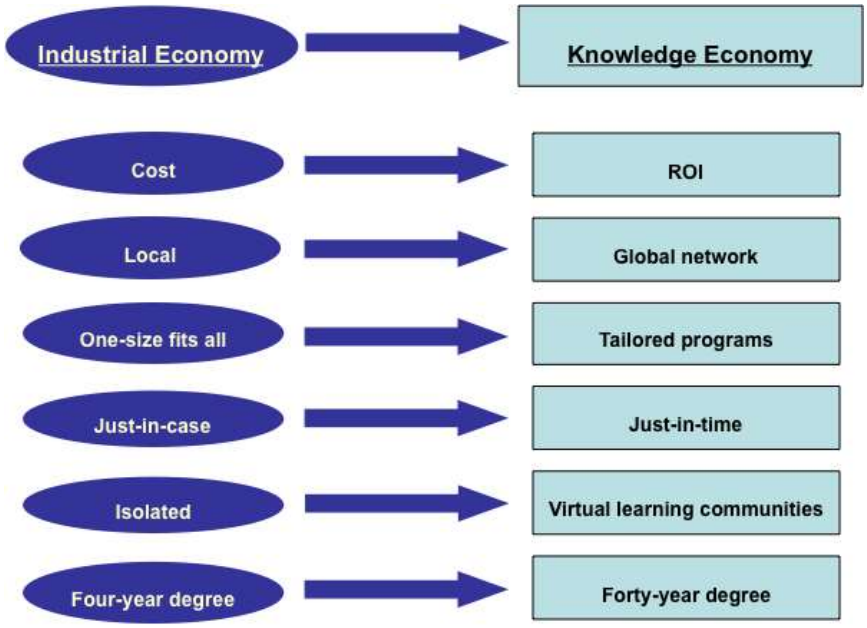
Colleges and universities need new tools to enrich coursework, enhance flexibility, and attract the best students and faculty. A Virtual Classroom distance learning solution supported by a BYOD policy enforced campus wide lets institutions of higher education reach students anywhere, anytime, while realizing a better return on technology investments by blending fully interactive and recordable audio, video, and Web conferencing capabilities on any capable device owned by the recipient. With this design, and using these tools, colleges and universities can extend the walls of their classrooms in both space and time, and bring the rest of the world to their campuses. Additionally, integrated into a single, comprehensive platform, these services can unlock a world of new opportunities for collaboration and communication among students, faculty, and staff. With an appropriate Virtual Classroom solution, colleges and universities can:

- Allow students and instructors around the globe to participate in live classes
- Record the entire classroom experience (including lectures, audiovisual and text materials, and both live and web-based Q&A interactions) for review by any student or instructor anywhere in the world who has been granted access to the course
- Use two-way audio, video, and IM tools to provide a fully collaborative distance learning experience instead of simply broadcasting lectures to passive listeners
- Bring in off-campus contributors and non-local speakers to enrich curricula

I- Challenges

As the adage says: the only constant is change. In this day and age, market dynamics revolve around customer centric demands. e-Age learning solutions are today's answers to colleges and universities growing pressures to:

- Maintain the highest academic standards in an increasingly competitive environment, both locally and globally
- Differentiate themselves from other institutions through state-of-the-art technologies and communication tools as well as exceptional curricula
- Compete for top faculty by improving instructional and scheduling flexibility
- Continue giving students access to outstanding faculty in the face of global instructor shortages
- Extend classroom learning and collaboration to students and faculty off campus
- ffer new and unique learning opportunities beyond what has traditionally been available on campus



II- Requirements

In any e-Age learning solution, the following features must be present:

1- Voice Conferencing

- In-session features such as roll call, break-out sessions, out-dial capabilities, and tools to monitor and restrict entry
- Ability to set up an impromptu session without making a reservation
- High Fidelity quality audio for better comprehension and comfort
- Automatic recording and playback of classes
- Ability to set up "listen-only" classes with Q&A sessions
- Comprehensive features to control classroom discussion

2- Web Conferencing

- Sharing and viewing of Microsoft PowerPoint presentations or any other non-video application with only a Web browser for clients
- Annotation of shared applications, presentations, and whiteboards
- Ability to automatically record and play back synchronized Web and voice content without the need for additional hardware or software on student/faculty PCs
- Instant messaging and polling capabilities
- Ability to grant control of the class session to students or presenters
- Multi-language support

3- Security

- Complete control to set up classes as internal only (behind the college or university firewall) or accessible to outside parties through the Internet
- Access authentication options that require all participants to authenticate themselves before gaining access to classes or materials
- Integration with college or university directories to ensure only legitimate students can access classes
- Encryption options, to protect sensitive information such as students' or instructors' personal data
- In-session classroom controls that allow class leaders to change participant permissions, require passwords, lock a class, and eject unwanted attendees

4- Administration

- Options to set parameters for system usage, scheduling, access, and preferences
- Customizable voice prompts and data fields

- Comprehensive reporting, including usage and billing information
- Capacity management tools
- Remote management and monitoring capabilities
- Disaster recovery tools
- Allow instructors to hold virtual office hours and meet with students privately and conveniently, without having to be in the same location
- Apply the same expanded geographic and temporal reach to staff and administrative meetings, faculty conferences, or other institutional gatherings, as well as courses
- Create immersion environments to teach foreign languages by conducting live classes with students and teachers from the culture being studied

III- Benefits

With a Virtual Classroom solution, institutions gain:

- *Enhanced curricula* – Colleges and universities can augment the learning experience with video, high fidelity audio, and rich media content that brings experts and knowledge from around the globe right into the classroom – and extends the classroom to participants around the globe.
- *Expanded reach* – According to research firm ThinkEquity Partners, more than 66 million adults and more than half of all employed persons in the United States participated in some form of continuing education through 2002. With the Virtual Classroom distance learning solution, institutions can capture a greater share of these and other opportunities by reaching out to new students and communities.
- *Reduced administrative burdens and costs* – Instead of acquiring an add-on distance learning solution that must be managed and operated separately.
- *Ease of use* – Many institutions have videoconferencing, but the service is underutilized because it is too difficult to set up and use. A Virtual Classroom solution's straightforward interface and point-and-click tools make it easy for even non-technical users.
- *Ease of Integration* – A Virtual Classroom solution should smoothly integrate with Microsoft Outlook and Lotus Notes, as well as with existing network administration and security services.
- *Strong security* – The Virtual Classroom should ensure the appropriate level of security protecting both students' and the University's data

We propose to respond to each of the above-mentioned challenges by providing a detailed report on a specific set of best of breed solutions we integrated and then deployed and currently operate at the American University of Central Asia located in the city of Bishkek in the Central Asian Republic of Kyrgyzstan. We consequently discuss in the following sections how we implemented virtual classroom capabilities in section A, how we extended the reach of our University beyond the grounds of the University Campus in section B, how we subsidized access technologies for all students, faculty and staff while preserving strict personal and corporate data protection and security in section C.

Section A: Providing Virtual Classrooms with Adobe Connect

I- Introduction

The prevalence of e-learning cannot be denied – 77% of US universities offer online courses.[1] While at the same time, the vast majority of students still feel that physical classrooms offer a superior learning experience – if one is able to attend in person[2]. Physical classrooms provide the classic venue for learning. No matter how many technological improvements are added they still represent the tried and true way for teachers and students to come together in the miracle of education. Although physical classrooms still clearly hold some disadvantages fundamental to their design:

- They are restricted in time and place
- They force the absorption of information at a rate that leaves the slowest students behind and the quickest students underachieving
- They do little to enhance the strengths of good teachers, but amplify the weaknesses of poor communicators.

---

1 http://www.pewinternet.org/2011/08/28/the-digital-revolution-and-higher-education/

2 http://www.usatoday.com/story/news/nation/2013/06/11/real-classrooms-better-than-virtual/2412401/

In every one of these aspects, virtual classrooms offer efficient ways to solve the problem. Physical classrooms are not all problems, though. They have at least as many strengths as weaknesses:

- Face-to-face communication often helps convey learning more effectively.
- Traditional distractions are limited (although electronic ones are likely still a problem)
- Interactions with the teacher and other students are more natural and may be more frequent.

So, what then is the answer – virtual or physical? Rather than accept this poor question – why not pose a better one: why does the experience need to be strictly online or physical? E-learning tools can certainly be used to deliver a purely virtual solution, but the hidden value of them is the potential to merge the physical and the virtual into a hybrid classroom. The physical class can still be given with the collaboration tool linking in remote students (either temporarily or permanently remote) and guest lecturers, and the system will record the class and the class information for later use by all students (and the teacher).

II- Choice of Virtual Classroom Software

The choice of collaboration software can be difficult, although a few factors may limit one's decision. The first is whether a hosted (i.e. "cloud") solution is viable or whether the tool must be run on a local server. All the commercial offerings provide hosted solutions, and their TCO is usually much less (as server roll-out and management, backups and disaster recovery, redundancy, and scalability are all handled by the provider). On the other hand, a hosted option requires more bandwidth and low latency to the commercial servers as well as limited data access and customization. For AUCA, latency and bandwidth prevented a hosted solution. In addition, open source options were decided against due to less maturity and thus an expectation of a higher maintenance footprint. In the end, Adobe Connect was selected. To support the hybrid classrooms, Connect provides the usual video and audio conferencing options as well as text chat, display of documents or desktops, virtual whiteboards, file sharing, polls, quizzes, attendance logs and archiving of class sessions. Common virtual classroom solutions are shown in table A-1.

Table A-1: *Common Virtual Classroom Solutions – Source: http://en.wikipedia.org/wiki/Comparison_of_web_conferencing_software*

Product	Company	License	Cost	Users Per class	Service Type	Limitations
BigBlueButton	BigBlueButton	Open Source	Free	1-80	Local	no encryption; No iOS support
Collaborate	Blackboard	Proprietary	Medium	1-1000	Cloud	
Connect	Adobe	Proprietary	Medium	1-1500	Local or Cloud	
GoToMeeting	Citrix	Proprietary	Medium-high	1-1000	Cloud	limited linux support
Lync	Microsoft	Proprietary	Low-Medium	1-1000	Local or Cloud	no linux support
OpenMeeting	Apache	Open Source	Free	1-125	Local	unclear mobile support
Skype	Microsoft	Proprietary	Low	1-25	Local	basic features only

III- Student View of Connect

From the student point of view, the Adobe Connect system is merely a web site that launches a flash application. For most users nothing needs to be installed, unless they have some how managed to use a web browser thus far without installing a recent version of Adobe Flash. Students can log in to a general web site and get a list of classes in which they are a participant (as well as search for files and recorded classes related to those classes). Or they can use a specific classroom URL to proceed directly to a virtual class. A student view of Adobe Connect is provided in Image A-1.

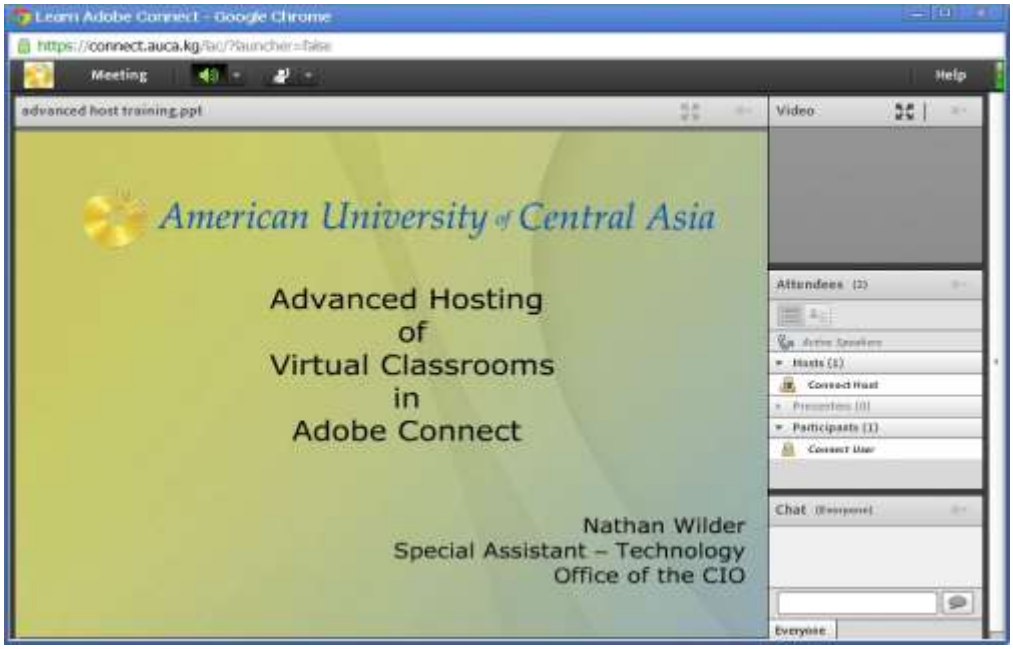


Image A-1: *Student View of Adobe Connect*

The bar along the top of the screen provides speaker settings as well as microphone and webcam if enabled by the teacher. The icon of the figure with the raised hand controls a student's status, which can involve not only raising a hand to ask a question but also agreement, disagreement, and requests to speed up, slow down, speak up or speak quieter. Each window in the Connect application is referred to as a 'pod'. So, in the image A-1 example the basic pods for Video (typically a webcam view of the instructor), Chat (chat defaults to being seen by everyone, but students can also send messages privately to the instructor or – if the teacher has enabled it – to other students), Attendees, and a large Sharing pod (which in this case is displaying a PDF based presentation). A student's view of the class is strictly controlled by the instructor and even interactive pods, such as Chat or Polls, are only interactive while the professor has those elements visible. In addition to displaying PDFs, the teacher can display PowerPoint files, play MP3s, or show images or MP4 movies. For more complex demonstration or other file types, the instructor can show a stream of his or her desktop as they perform some operation or open an Adobe-unsupported document in its native application. There are several pods other than the ones shown most notably the Files pod, which allows students to download files from within the classroom, and the Poll pod; which allows the instructor to give a simple poll or quiz using multiple choice (one answer), multiple answer, or short answer (a short sentence or phrase).

IV- Instructor View of Connect

As expected the instructor's view of Connect is much more detailed. In the web portal in addition to the list of their classrooms, instructors (hosts as Adobe calls them) can:

- create new classrooms
- edit existing classrooms
- build folder structures of shared files (associated or independent of a classroom)
- browse files uploaded from within a class session
- browse recorded classes
- view attendance reports
- view poll/quiz results
- change permissions on any of these resources to allow others to view them

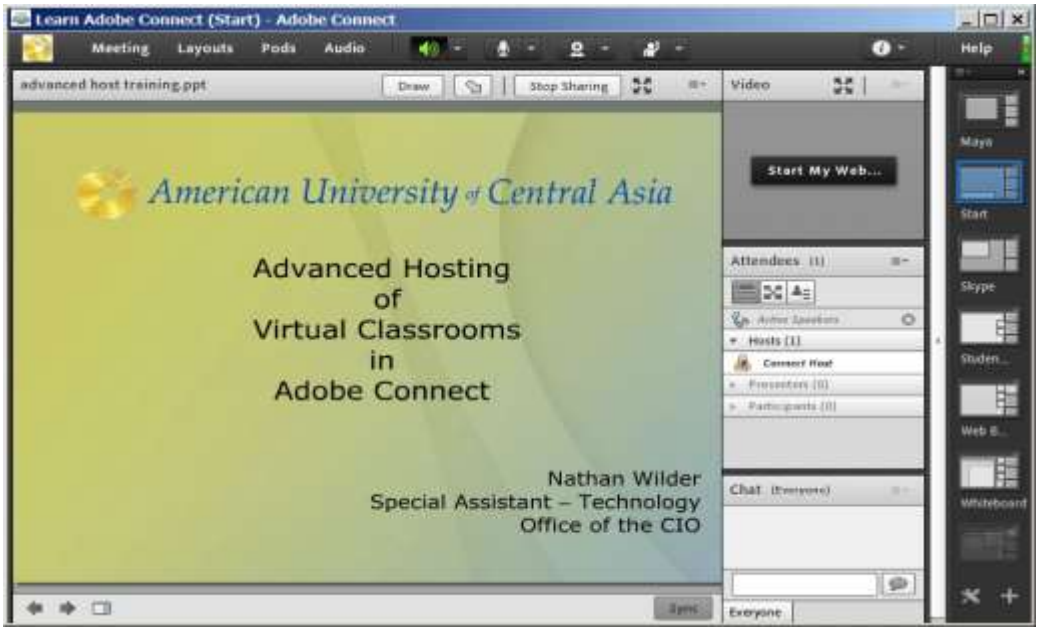


Image A-2: *Adobe Connect - Instructor View*

Within classrooms, teachers have the full range of options to control the experience. Image A-2 shows a typical initial teacher view of Connect. The bar at the top reflects a number of menus that have numerous options for recording classes, creating pre-designed layouts of pods, adding new pods to the room, and controlling the audio and video options of oneself and one's participants. As previously mentioned, the core Sharing pod can display certain documents, a virtual whiteboard or the host/presenter's desktop. The whiteboard functionality is really available in all these modes as a teacher can mark or highlight on top of their Powerpoint slides or freeze their desktop sharing and write or draw over the resulting screenshot image. Instructors can also select individual students in the attendees pod and activate their microphones, activate their webcams (the student must also activate on their end), allow the student to share their desktop with the group, or make the student a presenter. A presenter is a special role that allows one to temporarily control the sharing pods of the class in order to show a document or work out a problem on the whiteboard. Instructors also have the ability to enter a staging mode called Prepare Mode which allows for the arrangement, addition, and prep of pods. The changes in this mode are not visible to students until Prepare Mode is exited. Ideally though a teacher should never have to use Prepare Mode within actual class time as Adobe provides a feature called Layouts. In the vertical box on the far right of image A-2, one can see various layouts. Instead of arranging and adding pods during the class, the instructor creates a layout with pods in the proper positions for various points in the class. At each point, the appropriate layout is selected and all current pods (not included in the new layout) vanish and new pods appear in their pre-arranged spots. With this feature, it's easy to queue up a presentation, a short video, and student demonstrations on the whiteboard, all followed by a quick 10 question quiz at the end. And the layouts can be activated in any order, so it's simple to go back and forth from whiteboard to presentation while showing concepts.

V- Advantages for Students

When applied to education in a hybrid physical-virtual approach, Adobe Connect has resulted in a number of advantages for students, not all of which are immediately obvious.

- **Attendance flexibility:** The most obvious comes from flexibility in time and location. The average university student is often not the most organized, disciplined, or timely of persons. A system such as this will provide a learning safety net for these common academic lifestyle mistakes, while countering the errors not with leniency in grading or lowering of academic standards; but by providing an alternate path to sufficient learning and knowledge.
- **Repetitive note-taking eliminated:** Another advantage is removal of unnecessary repetition. While the physical classroom has the advantage of natural in-person communication, its advantage is limited by students being bound to rote methods of retaining instruction. Instead of tying up students with note taking, the hybrid classroom should take the notes for them and free them up to absorb, contemplate, and understand.
- **Increased Attention:** Finally, a less obvious student advantage is increased attention. Physical classrooms were designed with a limiting of distractions in mind. But today an instructor must battle for students' focus against their smart phones, tablets, laptops, and other devices. By putting the class on these devices as well as in the physical room, the personal devices can be neatly inverted to actually distract from the physical into the virtual classroom, delivering the same class content at the same moment.

VI- Advantages for Universities

In addition to the positive effects on students, there are a number of advantages for universities themselves.

- **Higher success rate:** By encouraging better student attendance (whether physical or virtual) and freeing students from rote note-taking, they should experience a higher rate of success, which will naturally reflect very well upon the institution.
- **Expanded customer base:** Hybrid classrooms like that delivered by Adobe Connect will expand the potential student base, particularly in the demographic of professionals looking to return to school while continuing to work (i.e. those potential students who likely have the highest incomes and the most time and location constraints).
- **Reducing physical hardware/facilities:** Another advantage is reducing redundant purchases, such as projectors, whose new purchases AUCA has already begun reducing. Also, the school is now no longer limited by the size of their physical facilities, and over time it may even be possible to reduce the size of those facilities or put them to non-traditional use.

VII- Potential Issues

All this being said, Adobe Connect and other hybrid approaches are not issue free. Some of these issues may include:

- **Student Training:** Student training is fairly straight forward and can be delivered in many cases during orientation week – especially if the emphasis will be on extending the approach primarily to classes for incoming freshmen. However, this method does necessitate waiting four years for a complete roll-out. A likely more satisfying technique is to train all freshman as a group, but also have teachers provide basic instruction to other students as they transition their non-entry-level classes into Connect.
- **Teacher Training:** In many cases, teacher training will be more challenging. Instructors need to know a great deal more about Connect in order to fully leverage it, and many may not be as comfortable with new technologies and programs as young students are. But with a full commitment to physical-virtual classes by school leadership and detailed materials, these training issues can be overcome.
- **BYOD Policy:** Another potential issue is a successful implementation of a Bring-Your-Own-Device (BYOD) Policy. The possibility exists for universities to supply laptops or tablets for every student in every classroom, but in the real world this is likely to be a very inefficient use of funds (assuming such large funds are even available). Instead, it is much more practical to utilize the fact that nearly all modern students have laptops, tablets or even large-screen smart phones. For those that do not have a device, a subsidy program can be implemented in concert with the financial aid department.
- **Network Capability:** The campus network must have the capacity and structure to support one virtual classroom for every physical one. An in depth discussion of this is beyond the scope of this paper, but it is not insurmountable and likely amounts primarily to ensuring a robust and scalable wireless design.
- **Academic Resources:** Other issues arise from the class and school resources. Any education materials (such as textbooks and supplemental reading) supporting a class should be in a digital format. Otherwise remote students may not be able to follow along with those physically on campus. Also, access to specialized software and digital library resources (which can sometimes not be open to the internet) must be available remotely. One solution to this Citrix XenDesktop discussed later.
- **User Attitudes:** Probably the most difficult issue to address to everyone's satisfaction is that the virtual interaction found in Adobe Connect (and similar variations in other conferencing products) may not feel natural for all people. Students raised alongside Facebook and SMS may be less likely to experience this, but the greater interaction comes from the usually older instructors. This is an issue that will become diminished as faculty use the software for longer periods of time.
- **Audio Management:** Management of audio is likely to be a common complaint. As in any conferencing product, everyone with their microphones on leads quickly to auditory chaos. Likewise, anyone using speakers rather than headphones must learn to turn off either their mic or their speakers at any given moment to avoid noise feedback. The simple solution to these problems involves starting any class with only the teacher's mic turned on. When students have a question, the teacher can either temporarily activate their mic or repeat the student's question or comment for the benefit of the teacher's microphone. Wireless headsets can be also be used by instructors to effectively manage any potential feedback.

In all, implementing Adobe Connect does lay down a few challenges, but it answers many more. The physical-virtual hybrid classroom provides the greatest access and abilities for an effort that is not at all herculean.

Section B: University Ubiquitous Presence through Citrix Virtual Desktop or ("LAN Extention")

I- Introduction

Attending an institution of higher learning is a classic way to obtain an education and advance one's career. Great advances have been made in the field of online distance learning, making it a better option for some students than in-person attendance.

This is particularly true for:

- employed students
- students that are in locations that do not have access to appropriate education
- students that need to maintain a flexible learning schedule
- students with disabilities
- students on trips and journeys
- students temporarily absent for health reasons
- women on maternity leave who want to keep up their skills to return to their former job at the end of their maternity leave

II- Advantages of distance-flexible learning

The main advantages of distance learning at AUCA

- **Flexibility:** Classes can be "attended" from any location with an Internet connection. If a class is missed, lectures are recorded and can be viewed when time permits. For many online learning programs, class times can be scheduled at non-traditional hours to accommodate those with special needs. Because there is no need to attend classes personally, students can develop their careers and still be a full part of the educational process. Study can be arranged around work, social, or family commitments. Students can study wherever they are. However, instructors can also teach their students from any place. It is especially convenient for part-time instructors, who might have numerous business trips and conferences. No matter where the student or the instructor is, as long as there is an internet connection she/he can easily take her/his part in the education process.
- **Convenience:** Distance learning technologies can provide access from convenient locations for both students and instructors. Many of the technologies, such as the Internet and telephone, are easily accessed at home. Others, such as videoconferencing, can be distributed from a single point (such as a university) to multiple remote sites (such as schools). Satellite transmissions can be viewed at specified sites, or the transmissions can be recorded for later viewing at home or school.
- **International Networking:** Distance learning can lead to networking with an even wider variety of people than you might encounter at a local institution. Because of the high level of flexibility that a distance learning program offers to people all over the world, it is common to network internationally. Audio teleconferencing is especially popular as a means of bringing distant experts into the classroom.
- **No Special Equipment Needed:** The BYOD policy allows students to participate to classes with their personal communication devices through which they will have access to all data and applications provided by the University. Personal devices include laptops, tablets, and smartphones running any of the following operating systems: Windows, MacOS, iOS, Android, Playbook, etc.
- **Guest Lecturers:** Another advantage is the fact that 'guest speakers' who cannot physically attend the courses can still participate to classes. The lectures organized by University are a great platform for interaction of students and highly qualified lecturers from around the world.
- **Self-paced Learning:** Students can quickly browse materials they have already encountered, and concentrate their time and effort on areas they lack. Students can study materials at their own personal speed and intensity, without having to wait for the slower pace of the average classroom. Or vice versa – student can repeat the lecture or any other material again and again in order to fully understand the topic, so no one in the class could say that someone just wastes time. Distance programs also often result in some unintended side effects such as: higher levels of communication and cooperation between schools and districts, parental involvement with courses, and exposure to or mastery of a new technology, which students and teachers can apply to other areas.
- **Effectiveness:** Not only is distance learning convenient, it is also effective. Several research studies have found that distance learning is equally or more effective than traditional instruction when the method and technologies used are appropriate to the instructional tasks, when there is student-to-student interaction, and when there is timely

teacher-to-student feedback.[3] [4]

- **Multi-Sensory:** One of the benefits of distance learning is that there is a wide variety of materials that can meet everyone's learning preference - at least part of the time. For example, some students learn from visual stimuli, such as video, and others learn best by listening or interacting with a computer program. If distance learning courses are well designed, they will likely offer learners a wide range of choices, thereby providing the optimal combinations of interaction and media.
- **Interactivity:** Contrary to popular opinion, distance learning courses can offer increased interactions with students. In particular, introverted students who are too shy to ask questions in class will often "open up" when provided the opportunity to interact via e-mail or other individualized means.[5] Through the increased interactions, teachers can better meet individual student's needs.

III- Use Cases

All scenarios are fictional although based on real cases and capabilities observed at AUCA.

Ainura stay-at-home mom

Ainura, 28, is a mother of two. Her elder son is now going to go to school and her daughter is only several months. Before her daughter was born Ainura worked as a bank clerk for 4 years. Now she is on a maternity leave until her daughter can go to pre-school. Ainura understands that in several months she can drop out of the work force market because she loses her skills and every day new employees arrive with fresh knowledge. Ainura knew that if she did not refresh her knowledge and skills she would lose her potential opportunity to get back to the workforce market very quickly. So she decided while she is on maternity leave she can upgrade her qualifications. But with little children it is hard to find a free minute. Only when her little girl sleeps Ainura can relax. Distance learning became an optimal solution for Ainura, she does not need to spend time and money for transportation to the site of the university. She is now able to take MBA classes at home. She does not need to sit several hours in the university to get knowledge, and she can be sure that her children are safely with her. She does not need to spend money for a babysitter and leave her children to some unknown person. While her baby girl sleeps and her son plays with his toy cars, Ainura carefully listens to the professor's lecture, which is full of the important information. The slideshow on her computer screen supports the words of the professor. Oh, Ainura's daughter woke up and her whimper tells Ainura that her daughter wants her meal. Ainura has to divert her attention away from the presentation and feed her daughter. She missed some parts of the professor's explanation, but it is not a big problem because the class is recorded. Any time she can download the session and listen to the lecture and see the presentation again and again.

Victor, the tardy student

Victor woke up late. In order to get to class on time, he swiftly turned on his tablet and joined the virtual classroom with the help of the distance learning possibilities given by the University. Now Victor is online and he can follow his first class for today. Simultaneously he called a taxi that has Wi-Fi, so he can follow the class even while en route to the university. The taxi came and now Victor is sitting in the taxi, listening to his professor and following the presentation shown on his tablet. Victor arrived to the university right in the middle of the class – he was late but he did not miss anything. His tablet switches between the Wi-Fi access points of his home, the taxi and the university smoothly and without interruption, so Victor can follow the whole class.

Giving wings to Nur's social ambition

Nur, 18, is a freshman and he is so excited about it. Beginning in childhood, Nur loved computers and computer games. He was always wondering how computers worked, how the games worked, what made pictures on the screen move and respond to the pressed button of the keyboard. He has read a lot books and articles on the Internet in order to find answers to his questions. Nur loves to spend time in front of the screen not only because it was so interesting, but also because he did not have a lot of friends. Infantile cerebral paralysis limited his physical capabilities and also limited his social activity. He rarely could go outside to play with the other children on the playground. He did not attend school; instead he got his

[3] Moore & Thompson, 1990
[4] Verduin & Clark, 1991
[5] Franklin, Yoakam, & Warren, 1996

education at home. Several teachers came to him to explain the material that his peers were passing at that moment. The parents of Nur always tried to provide him the best teachers so he could be at least on the same level as other children. Closer to graduation from high school, Nur's parents started worrying about his future – Nur should have higher education because his only meal ticket is an intellectual career. Nur had no doubts about what profession to choose – being a programmer was his definitive choice. The University provides him the best option. Nur being at home gets the same materials and the same instructions from the teacher at the same time as every other student by virtue of Adobe Connect. He sees the same presentation and listens to the same explanation of the teacher. At school time Nur did not have class mates to chat with, now he has many of them. They chat together during the class from time to time. Sometimes his class mates come to visit him to have a good time. Very rarely Nur can attend the actual classroom at the university site, it brings some discomfort, but it is so nice to be among people.

Section C: Subsidizing access technologies for all through the implementation of a BYOD program

I- Introduction

As mentioned previously, the capstone of AUCA e-learning strategy is the implementation of a "Bring Your Own Device" or BYOD Policy adapted to the academic environment. This initiative highlights the need of resolving several important issues within AUCA the goal of which is to raise the next generation of leaders of Central Asia. Twenty years have passed already, and now it is a time for AUCA to help its new generation - a generation that is not tied to the walls, is technologically advanced and mobile, is global and united - prosper and grow. AUCA introduces the idea of a global community that will grow not only by the number of people, but also in time and space.

Within the frameworks of the idea of community, wherever people go, they can carry AUCA with them as long as they have access to the global network. Students and faculty can work and study everywhere in the world and anytime they feel comfortable. This is possible with the introduction of solutions such as LAN extension and Adobe Connect. While LAN extension lets the AUCA community access data from any place, Adobe Connect lets it be present in classes and meetings at any time, as well as the vast advantages discussed earlier.

- The problem of data security remains with the above mentioned approaches. While AUCA wants to provide free and convenient access to information for its community, it cannot accept the full risk of leaving information open to anyone. Moreover, even within the community there are users who require full access to confidential data such as administration workers and users who need access to only education sources. This means that not only should access be limited to outsiders, but it also should be granular inside of the corporate network. Therefore, means of control should be introduced.

- Availability of devices per user is another issue due to the fact that all members of AUCA community will need constant access to the network. Buying PCs for each user and equipping classrooms with these PCs would be illogical and costly in terms of money and space. Moreover, users should be able to move freely and take their computers with them when they travel. Therefore, mobile devices and laptops owned by the users are best options. However, AUCA cannot force all users to buy their own device as around 80% of students are on scholarships and receive financial aid.

- The problem of supporting a wide range of heterogeneous devices. There are different types of devices and platforms used by students and AUCA should be able to support all of them.

To solve these issues AUCA introduced the Bring Your Own Device Policy with a stipend program. This policy would take control over security issues as well as other problems related to mobile learning. With the BYOD Policy in place, mobile learning requires fewer dedicated rooms and spaces. There is no need for keeping labs full of heavy desktops and computer cases. There is no need for the class to come to a particular room or wait until it gets free from other courses. Now learners can access the class from anywhere on their own devices.

When the Cisco® Internet Business Solutions Group (IBSG) interviewed nearly 4,900 business leaders and IT decision makers in nine countries from January to July 2012, it found out that 89% of employers allowed and even encouraged their

employees to use their own mobile devices such as laptops, smartphones, and tablets for work purposes.[6] Nowadays a BYOD policy is not just a novelty for many organizations. As students are next workforce generation, it is important to adapt them to a rapidly changing work environment.

Before there was no other way but coming to the student labs and offices for getting access to the corporate data. Due to security issues, only limited number of people had privileged access through the VPN connection. However, there is wide range of cases when urgent access to the data would increase productivity and endorse better communication.

II- BYOD considerations

Like most college campuses, AUCA already dealt with students bringing a wide variety of devices including laptops, smartphones, tablets, gaming boxes and more onto campus and expecting network access. However, users who owned devices never had access to the academic data except for select privileged cases.

User considerations

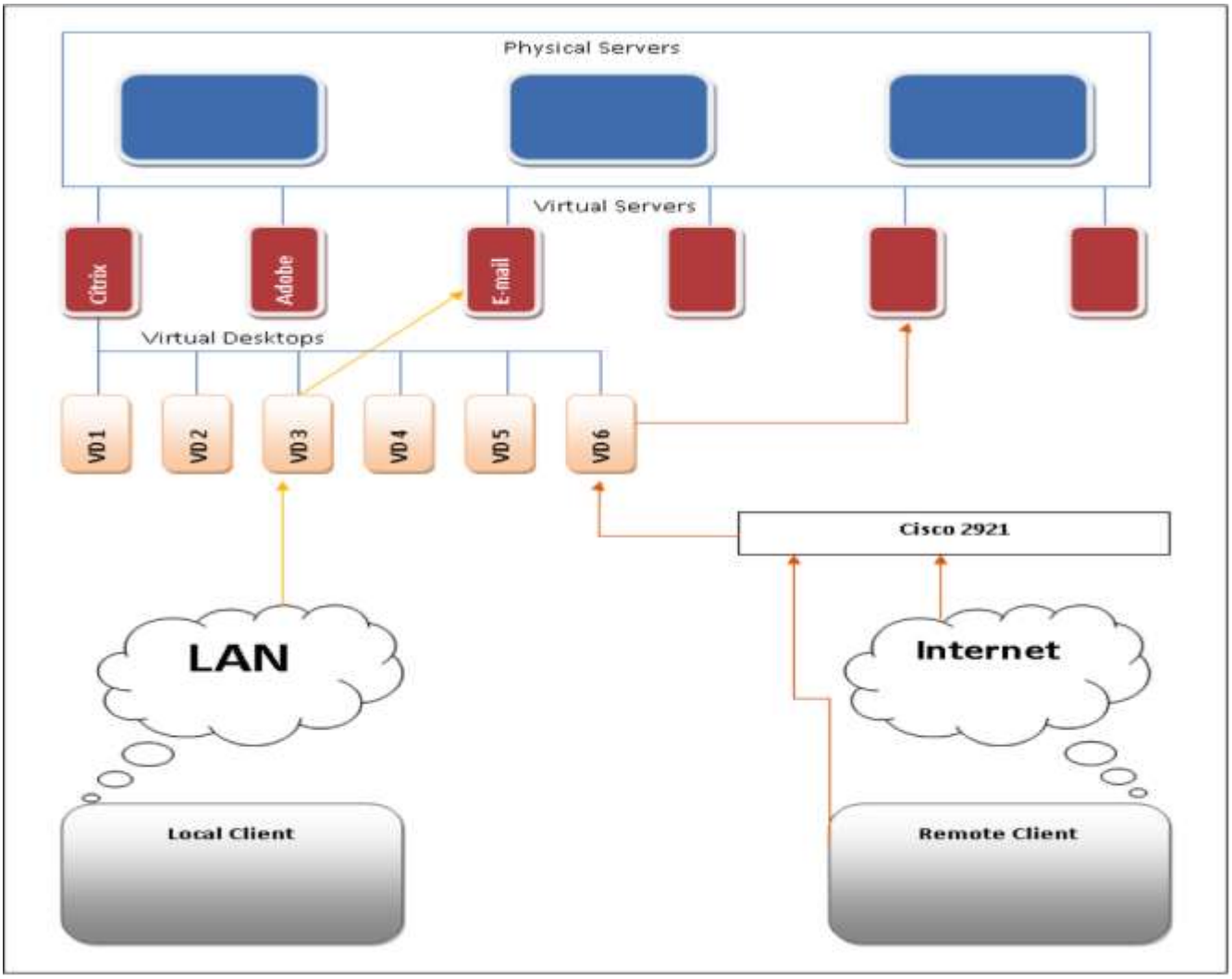
- Users want to be able to do everything related to work on a device that's full of personal pictures, files and other private information. Thus, one of the objectives was to balance securing business content while honoring user privacy.
- Users expect a consistent and reliable mobile experience. We are faced with the complexity associated with managing mobile devices and wide range of possible work locations. The BYOD development group was tasked to come up with a systematic means for managing business content rather than incorporating fragmentary solutions focused solely on managing the physical devices themselves.
- Users would want to use academic information from any device: usually faculty and students have at least two such (a laptop and a smartphone) from which they want 24/7 access to the resources. Therefore, an essential requirement is support of any computing device with a minimum of licenses purchased.
- Finally, in case of device loss or change in user status, AUCA should be able to update information without affecting their personal data.

Thus, in order to enable access on the user's own devices in their multiple variations there should be a distinct separation between personal and academic space with full control over the academic data and its management, but no control nor visibility on the personal data.

Institutional considerations

Cost reduction was a goal of the BYOD program. Replacing desktop, laptop computers, and other peripherals and parts every 3 years cost AUCA around $470,000 and disrupted the IT program and business users for several months. On the one hand, as the AUCA community grows with years, replacement and maintenance costs were to increase exponentially if other solutions were not introduced. On the other, AUCA could not consider installing and monitoring information security tools and programs on all types of devices that are to be employed by participants within the framework of the BYOD policy. Therefore, a key priority for AUCA was continuing a liberal BYOD policy that would enforce mobility of learning process and would be feasible for all while ensuring solid data security. To accommodate campus users while ensuring security for the corporate data and respect for personal space, and enabling limited guest access, AUCA implemented the BYOD policy through desktop virtualization.

[6] Jeff Loucks, et al., 2013



III- Virtualization platform

There are numerous software solutions for desktop virtualization such as Citrix XenDesktop, Oracle virtual box, VMware Horizon, and Microsoft VDI. Taking into account previous BYOD considerations and AUCA requirements, the Office of the CIO determined that Citrix provided the most appropriate choice to AUCA for the following reasons:

- **Stability and continuity:** As Kyrgyzstan is a developing country and technology is not prevalent everywhere, and as users often do not have great service providers, AUCA needs an application tolerant to uneven communication quality of service. Citrix XenDesktop uses UDP as a protocol instead of TCP. It brings the rule of best effort, users do not need to log-in and out again and again.
- **Management:** Citrix has one of the widest selections of enterprise management features from among the range of desktop virtualization products. It allows for centralized, standards-based handling of all the desktop administration elements.
- **Data security:** Citrix supports both the Virtual Desktop Interface (VDI) and Remote Desktop Server (RDS) provided by Microsoft whereas most of other types of software support mainly either VDI or RDS. In the BYOD program, while end user devices typically do not comply with corporate security policies, they can be infested with malware. With VDI, the end user device communicates directly with back-end servers through an encrypted session. Therefore, corporate data is safe from being damaged by viruses and malware. However, data is still not protected from being stolen or leakage. RDS has multiple possible solutions for protecting data from leakage through its various program options. With RDS, users have access to the desktop only which means that they cannot download or upload any information or send it via e-mail. Users still can work on their files and save them on network. Therefore, when combined, VDI and RDS are a great solution for protecting corporate data from both threats.
- **Compatibility:** In terms of client/server communication, not all virtualization vendors support all client platforms.

Most of the major vendors provide client components for Apple's iOS, Android and devices running the Remote Desktop Protocol (RDP), which are usually Windows tablets and phones. Citrix supports about 30 different platforms compared to other software vendors. Moreover, Citrix combines the application streaming and desktop virtualization products into one back-end infrastructure with a single management interface while other software solutions offer installing applications on the end-user devices. Desktop virtualization together with application streaming technologies can address most concerns around application availability and compatibility with the end-user devices.

- **Costs:** Citrix products run on any server hypervisor whereas VMware View requires VMware hypervisors. Moreover, VM ware is much expensive than Citrix.

IV- Hardware/Software

Following is the list of hardware and software required for the BYOD program:

- VMware for server virtualization
- Physical servers
- Citrix XenDesktop with licenses
- Microsoft RDP license for XenApp
- Cisco 2921 routers purchased with VPN licenses (SSL)
- Robust Storage Area Network and Core Network required

V- Bearing costs of BYOD Policy

With the introduction of the BYOD Policy AUCA cuts its costs on computer life cycles, updates, and maintenance of the computers, their parts and peripherals. At the same time each member of AUCA community now has to have at least one device for supporting the constant access to the corporate data and classes. Knowing that not all the students and staff can afford the cost of new device, AUCA introduces BYOD Stipend Program that provides financial aid to those who are eligible for the program. Therefore, savings from introduction of the BYOD Policy will help students not only take advantage of this policy, but also use other innovations such as ADOBE Connect and e-learning for their full potential.

VI- Section Conclusion

The BYOD Policy makes learning process much more convenient and reliable for the students. Because students keep their information on cloud, they do not have to change their device each time they need access to certain information, they only have to log in under their own account. This increases students' productivity and satisfaction. And again desktop virtualization eliminates the possibility of information to be stolen or lost.

Costs

The costs associated with these e-learning technologies will obviously vary according to the size of the university. For both Adobe Connect and Citrix XenDesktop there are both fixed costs and marginal costs associated with each additional student or teacher. In addition to the direct costs of licensing the software, there may be a need for infrastructure investment. Network hardware (routers, switches, wireless access points, etc.) and VPN licensing as well as server hardware are just a few of the potential items that may be needed. At the same time, evaluating these needs and costs is not insurmountable and infrastructure investment will almost certainly benefit other projects beyond these e-learning initiatives. The following table outlines some of the numbers that AUCA dealt with while rolling out this endeavor.

Project Software	Total Cost	Notes
Adobe Connect	$16 774,00	Server and meeting host licenses
Citrix XenDesktop	$38 300,00	Concurrent user licenses
Software Total:	$55 074,00	
Infrastructure Upgrades (Beneficial outside this project)		
Wired Network (Cisco)	$170 000,00	

Wireless Network (Cisco)	$136 000,00	
VPN Capability (Cisco)	$2 000,00	
Servers (Dell and VMWare)	$48 000,00	
Infrastructure Total:	$356 000,00	
Overall Total:	$411 074,00	

2. Final Conclusion

At the time of writing these lines, 82% of all AUCA students have been involved into these initiatives taking a total 77 different courses from 33 trained faculty members. We plan to develop further our virtual classroom capabilities by purchasing additional licenses within the next 36 months to achieve a 50-50 ratio between the number of student, faculty and staff present on the campus grounds and the ones that are virtually present. Additionally, as an important fringe benefit, because most courses delivered have been recorded (about 358GB of data for about 454 hours of lectures at this time), academic quality assurance can be monitored and maintained at all times in a much more efficient and effective manner and could ultimately be outsourced to third party organizations for accreditation purposes, intellectual property protection or other academic goals.

Lifelong Learning: A Roadmap for the Developing Countries

Ali YAZICI(1), Alipasa AYAS(2)
Software Engineering Department, Atilim University, 06836 Incek, Ankara, Turkey, ali.yazici@atilim.edu.tr
Graduate School of Education, Bilkent University, 06800 Bilkent, Ankara, Turkey, apayas@bilkent.edu.tr

Abstract: Lifelong Learning (LLL) is defined as all learning activities undertaken throughout life with the aim of improving knowledge, skills and competences, within a personal, civic and social and/or employment-related perspective. This article aims at discussing the main issues in LLL, using the approach in the European Union countries. Challenges in Turkey's recently completed European Union (EU) project "Promoting LLL in Turkey", and the current situation in the Arab world in the same context are summarized. Based on these cases, a roadmap and a set of recommendations for LLL in developing countries are given.

Keywords: Life Long Learning, LLL, e-Learning, RPL, Distance Education, Models of LLL

1. Introduction

Learning process can take three different forms: formal, informal and non-formal learning. *Formal* learning takes place, in most cases, in school settings where there is a curriculum and a sequence of planned teaching and learning activities are carried out with students at a certain age at primary and secondary stages. *Non-formal* learning is undertaken in a certain environment with a curriculum and planned activities but the age of participants may be quite different. There can be very young and even very old participants taking the same activity or course together to have a new skill. *Informal* learning occurs in cases where there is no pre-defined curriculum and activities on paper. It can happen during the daily life conditions. In other words, Informal learning occurs as a natural outcome of everyday work, community based activities and everyday life experiences. That is to say, we are constantly learning regardless of time and place.

The idea of lifelong learning (LLL) was introduced by UNESCO about 50 years ago. In 1996, the OECD Education Ministers agreed to develop strategies for "lifelong learning for all". Policy-makers in many OECD countries are now and have been trying to develop strategies to use all the skills gained "from cradle to grave"[1].

LLL covers all modes of learning throughout life: formal, non-formal or informal. At first LLL as a policy concept belonged only to the most developed countries around the world. In the last two-three decades it has a widening acceptance and area that something has to be done in developing and less developed country contexts. For example, a middle income country like Turkey spent major efforts for transformation of society as well as the skills of individuals. Bangladesh is an example among less developed countries which spent considerable time and effort for LLL [1]. OECD, despite its name and charter about economic development, takes a keen practical and applied interest in LLL to establish among its members a wider social inclusion, social capital and equity dimension [2]. It is often believed that lifelong learning if undertaken seriously it has direct economic impact to the development of country.

This paper will address some of the key issues in lifelong learning. In Section 1 basic concepts in LLL is discussed and the need for LLL is emphasized. Section 2 gives an overview of LLL in Europe. In Section 3, the recently completed EU project on "Promoting Lifelong Learning in Turkey" and its implementation strategy is given. In Section 4 Adult Education in the Arab States are reviewed. Section 5 gives a roadmap for designing LLL in developing countries Arab States. Finally, Section 7 provides concluding remarks.

2. LLL Concepts

Knowledge took 1,750 years to double for the first time, counting from the start of the Christian era; and it is projected that by 2020 knowledge will double every 73 days [3]. Humanity faces a new challenge in coping with this rapid change in knowledge and consequently, adopting himself/herself to this directly affected society. Knowledge, also known as

[1] OECD, 2014 retrieved from http://www.oecd.org/edu/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm

accumulated, analyzed and digested data/information, needs to be organized, stored, managed and utilized efficiently and effectively for its proliferation and for the well-being of humanity.

LLL seems to be the only answer to these challenges. LLL is defined as "all learning activities undertaken throughout life with the aim of improving knowledge, skills and competences, within a personal, civic and social and/or employment-related perspective [4]". LLL is not only a matter of economic necessity and, access to it is also essential for inclusion [5]. Basic literacy and basic IT and communication skills are often no longer sufficient for a better career, and as a result citizens with only basic skills are at increasing risk of social exclusion. Strengthening LLL within the system of education and training can support the people in rural areas, those individuals without literacy skills, people without an education, children and adults with special educational needs, and those without work and so on to gain the skills and/or qualifications they require for a more productive and fulfilled lives.

LLL Education/Training is implemented in one of the three forms, namely, formal, non-formal and informal education. The formal education refers to the education in the schools leading to a diploma, the non-formal education refers to the education/training most of the time leading to a diploma and/or qualification recognized by the related establishments, and finally, the last one is the education/training inquired by the people for self-satisfaction, career change, and hobby and so on. In Table 1 below, this classification is elaborated.

Table1. *Forms of LLL*

Education	**Where?**	**Organized by**	**Diploma/Certificate**
Formal	Schools	Public/Private Sector	Diploma
Non-formal	Schools, establishments, training centers	Public/Private (national, international) sector	Diploma/Certificate
Informal	Home, establishments, training centers	Municipalities, private sector	Possible

3. LLL in European Union

The European Commission (EC) issued a Memorandum of Lifelong Learning[2] in 2000 which provided a set of strategies for implementing lifelong learning in Europe. In 2001, a plan of action was published[3] to help countries modernize their LLL systems.

The priorities for developing lifelong learning systems were identified by the EC[4] as:

- Providing access to lifelong learning opportunities for all, regardless of age, including specific actions aimed at the most disadvantaged persons, those not participating in education and training, as well as migrants, as a means of facilitating their social integration
- Providing opportunities to acquire and/or update basic skills, including the new basic skills, such as IT skills, foreign languages, technological culture, entrepreneurship and social skills
- The training, recruitment and updating of teachers and trainers for the development of lifelong learning
- The effective validation and recognition of formal qualifications as well as non-formal and informal learning, across countries and educational sectors through increased transparency and better quality assurance
- The high quality and broad accessibility of target group specific information, guidance and counselling concerning lifelong learning opportunities and their benefits
- Encouraging the representation of relevant sectors, including the youth sector, in existing or future networks and structures, working in this area.

---

2 Commission of the European Communities (2000) *A Memorandum on Lifelong Learning* October 2000 Brussels.

3 European Commission (2001) *Making a European Area of Lifelong Learning a Reality*.

4 EC (2002) *Resolution on Lifelong Learning* 27 June 2002 2002/C 163/01.

The 2001 plan of action was revised in 2009, and adopted the Strategic Framework for European Cooperation in Education and Training[5]. It sets four objectives for LLL in Europe:

- Making lifelong learning and mobility a reality
- Improving the quality and efficiency of education and training
- Promoting equity, social cohesion and active citizenship
- Enhancing creativity and innovation, including entrepreneurship, at all levels of education and training.

A set of seven[6] benchmarks have also been developed and countries are monitored in terms of progress towards these. The aim is that these targets are to be reached by 2020:

1. At least 95% of children between 4 years old and the age for starting compulsory primary education should participate in early childhood education
2. The share of 15 year olds with insufficient reading, mathematics and science should be less than 15%
3. The share of early leavers from education and training should be less than 10%
4. The share of 30-34 year olds with tertiary educational attainment should be at least 40%
5. An average of at least 15% of adults (age group 25 to 64) should participate in lifelong learning
6. At least 20% of higher education graduates and 6% of 18-34 year olds with an initial VET qualification should have had a period of study or training abroad
7. The share of employed graduates (20-34 years old) having left education and training no more than three years before the reference year should be at least 82%

As part of its commitment to LLL, the EU adopted the *European Framework for Key Competences for Lifelong Learning.* The framework defines eight key competences that citizens require for their personal fulfillment, social inclusion, active citizenship, and employability in the EU's knowledge based society as follows: [7]

1. Communication in the mother tongue
2. Communication in foreign languages
3. Mathematical competence and basic competences in science and technology
4. Digital competence
5. Learning to learn
6. Social and civic competences
7. Sense of initiative and entrepreneurship
8. Cultural awareness and expression

Within the context of the *Europe 2020* Strategy and its commitment to strengthening systems for lifelong learning, the EU defined a renewed European agenda for adult learning [6] in 2011.

In Figure 1 below, percentage of population aged 25-64 participating in LLL is shown in the year 2012.

[5] EC (2009) Council Conclusions of 12 May 2009 on a strategic framework for European cooperation in education and training ('ET 2020'). OJ C 119 , 28.5.2009, p2-10. Brussels

[6] Source: EC (2012) Education and Training Monitor EC: Brussels

[7] EU (2006) Key Competences for Lifelong Learning – A European Framework. Annex of the Recommendation of the European Parliament and the Council on key competences for lifelong learning published in the Official Journal of the European Union 30 December 2006.

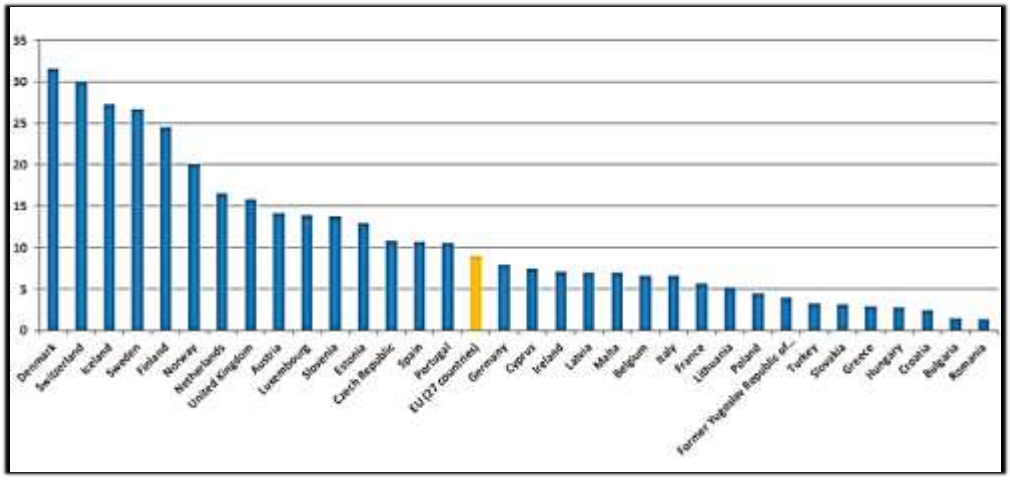


Figure1. *Percentage of population aged 25-64 participating in LLL (2012)*

4. Challenges in the Turkey's LLL Project

Project for Promoting LLL in Turkey [5] made a huge impact to set a target of achieving adult learning participation rates of 8% (from 2.6% in 2012) by 2015. Achieving this goal will require the involvement of all stakeholders in the lifelong learning system including public and private providers, NGOs and foundations, enterprises, worker organizations and employer bodies.

Turkey faces a number of challenges that must be addressed if an effective LLL system is to be developed. These include the need for:

- Greater public awareness of LLL
- Improved coordination and governance of LLL
- Improved data on lifelong learning and better monitoring and evaluation
- Improved career guidance
- A national qualifications framework to support LLL
- Improved quality assurance of delivery of LLL
- A system for recognition of prior learning
- Adequate and effective financing of lifelong learning
- Improved linkages between education and work
- Improved levels of school attainment to create solid foundations for lifelong learning

EU member states are encouraged to develop national LLL strategies in which they define priorities for action that will lead to improvements in the lifelong learning system and help progress towards meeting the EU benchmarks. In Turkey, the National Strategy for Lifelong Learning 2009-2013 was developed in 2009 and is currently being implemented. The Strategy includes actions in all parts of the education system to improve the performance of the system and address the challenges identified above. The strategy also includes several activities to strengthen the non-formal education and vocational training system and to improve its quality. The Strategy for 2014-2018 is currently under development.

The development of a LLL system is essential for Turkey's economic and social development. Turkey is pursuing a course of development aligned with EU policy and set out in the National Strategy. For this purpose, policies should be set out for:

- An institutional structure for coordination of lifelong learning
- Action planning for lifelong learning
- Partnerships with labor market actors and private sector
- Funding of lifelong learning
- Monitoring and evaluation of lifelong learning
- Qualifications and credit for lifelong learning
- Quality assurance of lifelong learning
- Recognition of prior learning

5. LLL and Adult Education in the Arab World

Academic investigations of adult education, literacy, and in general, lifelong learning in the Arab region are a rarity with the exception of reports from UNESCO and UNDP on the subject [7]. Moreover, only adult education underpins the general concept of lifelong learning which is aimed at reducing the high illiteracy rates in the region. Lifelong Learning for the information professions (librarianship) is considered in [8] and challenges and opportunities for promoting LLL in the Arab world are discussed. In [9], authors investigate the Gulf Cooperation Council (GCC) countries and emphasize the need to create new mechanisms to promote skills upgrading and the development of required competencies across the workforce in the form of LLL. They further put forward issues in forming a viable strategy in this area, by considering the importance of merit-based promotion, cross-generational collaborative learning, workplace-related competence development and adult education. University of Glasgow project "Lifelong Learning in Palestine"8 addresses the international development and the indigenous learning needs of the Palestinian people.

2009 Regional Synthesis Report written by A. A. Yousif [10] which elaborates the state and development of adult learning and education in the 17/21 Arab States gives a clear picture of the adult education and LLL in the Arab world. In the report certain facts and challenges are presented:

- About 65 million adults are illiterate (%0.9 of the total world population)
- There is a considerable gender gap in terms of literacy
- There is a major mismatch between the labor market needs and output of educational systems
- Poverty and deprivation remain real in many states
- Dependency of the region on other countries/states
- Intuitional arrangements that can transform the huge potential of the states into a well-developed infrastructure to cope with the global issues and challenges of LLL

The report continues with the challenges facing education, adult and youth literacy, the relevance of LLL to the current educational situation, policies and strategies, and implementation of national programs. In the conclusions section, report summarizes the facts, challenges, and problems associated with the adult education in the 17 states. Some of these relevant to LLL are listed in Table 2 below. The second column is added to classify the issue under a general LLL subject area:

Table2. *Facts, Challenges and Issues in Adult Education in 17 Arabic Countries*

Facts, challenges, issues	Subject Area
1. Quality of provision of adult education services is low.	Quality Assurance
2. There is no discussion in the national reports on LLL as a broader concept that encompasses all levels of adult education.	Lifelong Learning – Awareness raising

8 University of Glasgow Center for Research and Development in Adult and Lifelong Learning (CR&DALL)

3. Regional cooperation is at a low level.	Regional cooperation (with the stakeholders)
4. Only a few states considered linking their adult education programmer to international initiatives.	International cooperation
5. Financing is primarily a responsibility of governments. Private sector's contribution is negligible.	Financing
6. There is no evidence that learners are consulted about their educational needs.	Assessment/Auditing

6. A Roadmap for a Successful LLL Implementation

A successful implementation of LLL will be required to overcome the challenges listed in Section 4 above. However, before this step a wider acceptance and awareness of LLL in public need to be established. It is obvious that there is no universal strategy in implementing LLL throughout a country. That is to say, there is a clear need for each country to develop their own way to deal with issues in LLL implementation. However, there are four common steps to be taken as suggested by [11]:

- Governments, social partners, civic society, and the education and research communities should establish a close cooperation
- A common roadmap should be accepted by all relevant stakeholders
- An adequate provision of Basic Skills training (BST) for adults especially for those with low qualifications should be provided
- A set of indicators need to be developed to track the implementation of LLL

Based on above ideas a roadmap for an effective LLL implementation is necessary. Then the question to be raised is "what should a LLL implementation roadmap include for developing countries in general?" The following can be used as a basic model:

1. Develop a structure of LLL: To do this a close collaboration among the stake holders need to be established. In centralized educational systems this can be a unit at the capital city and sub-units can be in local areas. To develop a strategy to increase public awareness of LLL: To use mass media and social forums to introduce advantages of LLL for adults.
2. Develop a framework to be used for vocation competencies for each job or skill: To do this a unit should be established as "Vocational Competency Development Unit"
3. Develop a strategy for recognition of prior learning: In order to increase public participation a way should be developed for recognition. In this process test centers (Voctest Centers) should be established.
4. Develop an accreditation system to monitor the LLL activities: A quality management office should be established to collect data from all parts of the system and suggest alternatives for further development of LLL implementation.

The above five steps are not for a full establishment but rather it provides an idea for the basis of the LLL process in a country where there is a new attempt or just started actions on LLL.

7. Conclusions

LLL is a terminology used over the last five decades. It is now widely accepted by almost all countries, from developed to the least developed one. Since knowledge growth rate and its transformation into technology and its inevitable effects on the society are so high, LLL approach would be unavoidable for every country. At the same time, because of the globalization upsurge, no country can stay aside from this cycle. However, as indicated above, there is no straightforward recipe for the countries to adopt in developing and implementing LLL in an effective manner.

LLL, if developed with the ideas stated in Section 6 above, its beneficiaries will be able move around the globe easily and possibly develop better career opportunities in the job market. There are good examples noticed among EU countries as they developed a framework [6] for LLL and tools for mobility within EU borders. Developing countries including the

Arab States should use the experiences that the developed countries have gained during the development of a unique system. As mentioned above Arabic states still have very little progress towards a sound LLL system. Following the successful implementations in the world, a developing country can develop its own LLL system based on the existing tools, and considering the cultural and regional constraints.

As a final word, we argue that the roadmap presented above could be used as pillars of a new LLL system for developing countries. The most important initial step is to establish a joint platform which includes representatives from the business market, trade unions and syndicates, municipalities, government representatives as well as educators and other key figures in the society. Such an approach will hopefully contribute to developing countries to establish and implement their own LLL system.

8. References

[1] Arthur, J., Interim Report, *Recognition of Prior Learning:* Mission 2. TTVET Reform Project, Bangladesh, 2009

[2] OECD, *Qualifications Systems, Bridges to Lifelong learning*, 2007

[3] C.T. Bernheim and M. de Souza Chaui, *Challenges of the university in the knowledge society, five years after the World Conference on Higher Education*, Unesco Forum Occasional Paper Series Paper No.4, 2003

[4] MEGEP (2006) *Driving Force for the Success of Turkey. Lifelong Learning Policy Paper*. Ankara. October 2006

[5] Draft Policy Paper, *Project for Promoting Life Long Learning in Turkey*, TR07H2.01-01/001, Ministry of Labor, Turkey

[6] *EU (2011) Council Resolution on a renewed European agenda for adult learning*. Official Journal of the European Union. 2011/C 372/01) 20 December 2011

[7] Hamoud, H. R., *Illiteracy in the Arab World*, DVV International, Number 66: Education for All and Literacy, 2006

[8] Johnson, I. M., *Lifelong Learning – challenges and opportunities for the information professions in the Arab world*, 2008, Last accessed: July, 2014, http://eprints.rclis.org/16179/

[9] Chaib, M., *Establishing a new framework for lifelong learning*, Chapter 15 in: Andersson, T. and Djeflat, A., *The Real Issues of the Middle East and the Arab Spring: Addressing Research, Innovation and Entrepreneurship*, (Google e-Kitap), Springer Science & Business Media, 2012

[10] Yousif, A. A., *The state and development of adult learning and education in the Arab States:* Regional Synthesis Report, UNESCO Institute for Lifelong Learning, Germany, 2009

[11] Bengtsson, J. *National strategies for implementing lifelong learning (LLL) – the gap between policy and reality: An international perspective*, Int Rev Educ (2013) 59:343–352. DOI 10.1007/s11159-013-9362-4

Authors biography:

Name: Ali YAZICI

Institution: Atilim University

Full Address: Atilim University, Department of Software Engineering, 06836 Incek, Ankara, Turkey

Fax: +903125868091

Email: ali.yazici@atilim.edu.tr

Short CV

Prof. Dr. Ali YAZICI is a full-time Professor and the Chairman of the Software Engineering Department at Atilim University, Ankara, Turkey. He received BS (1972), and MS (1974) degrees in Mathematics from the Middle East Technical University (METU), Ankara, Turkey. He has completed his PhD dissertation (1983) at the Computer Science Department, Waterloo University, Canada. His research interests include Symbolic Computing, Parallel Computing, Cloud Computing, Database Systems, and e-Topics. In the last 30 years he has been affiliated as a full-time academic staff with Middle East Technical University, TOBB University of Economics and Technology, and Atilim University (Turkey), Yarmouk University (Jordan), and Sultan Qaboos University, (Oman). During his academic career, he acted as thesis supervisor of about 30 MS and PhD students. He is the author/co-author of more than 100 articles, books and research reports in the field of Computing and Informatics. Among many others, he is involved in "Promoting Turkey's LLL" EU project between 2010-2012 as a consultant and trainer. He is a founding member of Turkish Mathematics Foundation (1990-), an associate member of Turkish Informatics Society (1985-), and a founding member of Turkish Informatics Foundation (1990-).

Name: Alipaşa AYAS

Institution: Bilkent University

Full Address: Bilkent University, Graduate School of Education, Bilkent University, 06800 Bilkent, Ankara, Turkey

Email: apayas@bilkent.edu.tr

Short CV

Prof. Dr. Alipaşa AYAS is a fulltime Professor in the Graduate School of Education at Bilkent University, Ankara, Turkey. H received undergraduate degree from Karadeniz Technical University Faculty of Education in 1985. His graduate degrees are MS from Karadeniz Technical University, Master in Education (Curriculum and Instruction-science education) from University of New Brunswick, Canada and PhD in Education (Curriculum and Instruction-science education) from Southampton University, U.K. He has had administrative roles at KTU, which includes 6-year deanship in the Faculty of Education. He has involved in several research projects including National Education Development Project, Basic Education Support Project (Effectiveness of Public Education Centers), MEBGEB Project and LLL Development Project for Turkey. He was a member of Turkish National Teacher Development Committee for three years. He is head of Association for Accreditation of Education Programs in Turkey. Also, he was a member of curriculum development committee in chemistry for 2013 and material development process for chemistry at secondary level. He published over 100 articles, co-authored several books and supervised 22 PhD and 30 Master theses.

Shared Computing Infrastructures: a Regional Operational Approach

Ognjen Prnjat
Ioannis Liabotis, Greek Research and Technology Network
56, Mesogion Av. – 11527 Athens – Greece
{oprnjat, iliaboti}@admin.grnet.gr

Abstract: Modern research relies on the ability to share storage and computational resources, as well as algorithms and data, between research groups on national, regional and global levels. This paper presents a case study for regional organization of computational resource sharing and joint operations, enabling international research over a spectrum of scientific fields. The case study is based on 10 years of multiple high-end technology projects in South-East European region, including both Grid Computing and High-Performance Computing. The case study is considered as a useful model for organising computing resource sharing in other world regions, including the Arab region, as currently promoted by the project CHAIN-REDS.

Keywords: eInfrastructure, HPC, Grid, regional operations.

1. Introduction

eInfrastructure in Europe has reached a mature state where the GÉANT [1] network forms a communications backbone on top of which a high-throughput distributed computing infrastructure – the European Grid Infrastructure, EGI [2] – provides processing and storage services for eScience research; while the high-performance computing (HPC) landscape is dominated by PRACE [3] initiatives which support large super-computing facilities. The South-East European eInfrastructure initiatives are committed to ensuring equal participation of the less-resourced countries of the region in European technological and research trends. SEEREN [4] initiative has established a regional network and its GÉANT connection and the SEE-GRID [5] initiative the regional Grid. The regional approach for the Grid computing not only provided a common platform for regional research, but has also facilitated all 14 countries in the region to join the pan-Europe EGI infrastructure.

The regional vision of establishing an eInfrastructure compatible with European developments, and empowering the scientists in the region in equal participation in the use of pan-European infrastructures, required a set of coordinated actions in the area of HPC and application fields making use of HPC resources. Moreover, the regional scientists and engineers needed to be provided with access to HPC facilities of leadership-class to remain competitive on the international level, thus overcoming fragmentation in Europe. This vision has been materialised by the HP-SEE project [6].

This paper presents the experience in building Grid and HPC infrastructures in a region where state of the art is comparable to that of Arab countries currently. First, the paper briefly presents the regional approach to Grid computing, and then describes in detail the regional collaboration in HPC. The paper concludes by proposing that these kinds of solutions are also applicable to the Arab region – an approach supported by the CHAIN-REDS project.

2. Grid computing: the SEE-GRID project series

After 6 years of cooperation in the framework of SEE-GRID project series [5], a full-blown Grid computing infrastructure was deployed bringing together resources from 14 countries in South-East Europe. The regional team operated the Grid infrastructure and maintained the core services for SEE-GRID Virtual Organization (VO) and three dedicated disciplinary VOs. A set of operational and monitoring tools was used to manage and assess status of the infrastructure. The average availability of Grid sites was higher than 90%, the average number of available CPUs above 3000 (only for dedicated regional collaborations), while the total available storage around 510 TB. The key to successful regional operation was the distribution of the operational and management tools over a number of countries, as well as fail-over backup tool availability. The SEE-GRID regional infrastructure was successfully merged with the pan-European European Grid Infrastructure in 2010. Details of infrastructure operations are given in [7].

Fig.1. *SEE-GRID Regional Grid infrastructure*

The three champion VOs were as follows. Seismology VO had six applications ranging from Seismic Data Service to Earthquake Location Finding, from Numerical Modelling of Mantle Convection to Seismic Risk Assessment. Meteorology VO, with two large-scale applications, followed an innovative approach to weather forecasting that uses a multitude of weather models and based the final forecast on an ensemble of weather model outputs. Environmental VO supported eight applications focusing on environmental protection/response and environment-oriented satellite image processing. All of the applications typically involved a number of diverse research groups across the region. Moreover, strong regional collaboration has been encouraged in all the three scientific domains supported by the project via the deployment of specific support mechanisms that facilitate their communications and exchange of expertise. The national cohesiveness regarding grid computing was ensured by establishing National Grid Initiatives in all countries in the region.

3. High-Performance Computing

3.1 HP-SEE: the project

HP-SEE project was set up across several strategic lines of action. First, it aimed to link the existing HPC facilities in the region into a common infrastructure, and provide operational and management solutions for it. It also aimed to procure a GEANT link to Southern Caucasus to provide access to these communities to the regional HPC infrastructure. Second, it targeted to open this infrastructure to a wide range of new user communities, including those of non-resourced countries, fostering collaboration and providing advanced capabilities to more researchers, with an emphasis on strategic groups in computational physics, computational chemistry and life sciences. Finally, it aspired to act as a catalyst for establishment of national HPC initiatives, and as a SEE bridge for PRACE.

HP-SEE kicked off in September 2010 for a duration of 3 years, and was an initiative carried out within European Commission's Seventh Framework Programme under Research Infrastructures: it aspired to contribute to the stabilisation and development of South-East Europe, by easing the digital divide and stimulating eInfrastructure development and adoption by new user communities, thus enabling collaborative high-quality research across target scientific fields. The initiative was coordinated by the Greek Research & Technology Network (GRNET) and the project consortium consisted of representatives from Bulgaria (IICT-BAS), Romania (IFIN), Turkey (TUBITAK), Hungary (NIIF), Albania (UoPT), Bosnia-Herzegovina (UoBL), FYR of Macedonia (UKIM), Serbia (UOB), Montenegro (UOM), Moldova (RENAM), Armenia (IIAP NAS RA), Georgia (GRENA), and Azerbaijan (AZRENA). In order to ensure the necessary critical mass, 11 regional Research and Academic institutions have been selected to participate in the project as 3rd parties to the consortium partners, and the entire project is further strengthened through collaboration with PRACE [3] and LinkSceem [8] projects, and concertation mechanisms.

HP-SEE aimed to involve and address specific needs of a number of new multi-disciplinary international scientific communities (computational physics, computational chemistry, life sciences) and thus stimulate the

use and expansion of the emerging new regional HPC infrastructure and its services. HP-SEE was to capitalize on the existing human network and underlying research infrastructure to further strengthen scientific collaboration and boost more effective high-quality research and cooperation among participating SEE communities. The inclusion of the new Virtual Research Communities and the setting up of the infrastructure, together with a set of coordinated actions focused on setting up HPC initiatives in the region, aimed to contribute to regional development aims to ensure that countries in this region join the pan-European HPC trends.

3.2 HPC infrastructure

The objective in this context was to provide and operate the integrated South-East European eInfrastructure and specifically the HPC eInfrastructure for the region. In the project context this focuses on operating the HPC infrastructure and specific end-user services for the benefit of new user communities, and establishing the continuation of the GÉANT link to Caucasus.

Fig.2. *HP-SEE Regional HPC resources*

This activity ensured the stable operations and expansion of the heterogeneous regional HPC infrastructure that has been established. Currently the infrastructure comprises of two supercomputers IBM Blue Gene/P and several HPC clusters with low-latency interconnection, reaching a total of more than 150 Teraflops from CPUs power and more than 100 Teraflops from GPUs. The versatility of the infrastructure is further enhanced by the presence of a big SMP machine SGI UltraViolet 1000. In the final stages of the project, the ramping-up of production utilization of the HPC resources by applications from the Pilot Call and the Fast Track mechanism presented new challenges for the supporting teams of the provider partners. The gradual improvement and addition of new features to the core services and monitoring tools, especially the authentication, resource management and accounting systems, enabled the load of these new applications and the pre-approved applications from the target Virtual Research Communities to be handled properly. The increased take-up of GPU resources mainly by newer applications guided the process of deployment of software and libraries at the resource centres and impacted the planning process for procurement of new hardware. New storage resources have also been added, providing basis for more data-intensive applications to be supported. The process of guiding and in some cases migrating applications to the most suitable resource centres contributed to the efficient utilization of the heterogeneous regional HPC infrastructure.

Distributed set of services supports the infrastructure operations. These include the AAA framework: Resource Management System, ARC-LDAP service, and the Accounting System; as well as the Helpdesk (Request Tracker based) and Monitoring (Nagios plus local tools). The tools are fully distributed across the countries and teams involved in HPC infrastructure operations, ensuring joint responsibility for HPC operations and the spread of the expertise and know-how.

The South Caucasus link to GÉANT (Sofia-Yerevan and Sofia-Baku) has been established in 2012, and is since then been operational. The Network Operations Centre ensures smooth network operations, and detailed information about the links performance is available, including parameters like Mean Time to Restore (MTTR) and Mean Time Between Failures (MTBF). Reports are publicly available on the HP-SEE Monitoring Website and can be accessed by the following link: http://hp-see.ulakbim.gov.tr/reports.html. A powerful monitoring infrastructure was installed and necessary software tools are kept updated. Weathermap software supports rrd

data format and monitoring of additional network parameters. IPv6 traffic statistics for both NREN are available on HP-SEE Monitoring Website. Additionally, actions intending to increase IPv6 traffic in Armenia and Azerbaijan links were carried out.

3.3 HPC application communities

Regarding the application communities, the objective was to engage multi-disciplinary research communities from the region in close collaboration in a number of scientific fields with specific needs in massively parallel execution on powerful computing resources. The project enabled application porting and support for the scientific fields on regional HPC infrastructure.

The project fully reached the objectives of the Virtual Research Communities support regarding the porting, optimisation, deployment and usage of the applications, together with the provision of programming techniques guidelines. The infrastructure created, operated and upgraded continuously in the duration of the project, and the general procedures defined were used for the porting and deployment of applications, with support provided by the technical staff.

The total number of HP-SEE computing projects of the 3 core VRCs (computational Physics, computation chemistry, life sciences) that reached their objectives using the regional HPC infrastructure was 25. All the three initial VRCs significantly engaged their user communities, which benefited from the support for porting, testing, optimization and deployment of the applications, and training and sharing of expertise.

Major added value was provided in the context of support for new research communities, by having 13 new applications approved and granted access to the HP-SEE infrastructure in the framework of the Pilot Call for HPC resources for year 2013. 9 more applications were accepted through the continuous call for fast track access to HPC resources. Due to the successful promotion of the use of HPC resources in the under-represented areas, the two access mechanisms above have provided HPC resources to 22 (13 pilot + 9 fast track) new applications in Life Sciences, Computational Chemistry, and in new fields such as Engineering, Space Sciences, and Bioengineering. Figure 3 shows the breakdown by Virtual Research Community. The new applications supported have proved their capacity for producing new scientific results in advanced research domains through the publication of scientific communications in peer-reviewed journals and conference proceedings. Also, a considerable potential was proven in what regards the social impact in the region of the results obtained from the HP-SEE applications. Last but not least, the HP-SEE research communities have developed strong regional and international scientific collaborations in the target research areas.

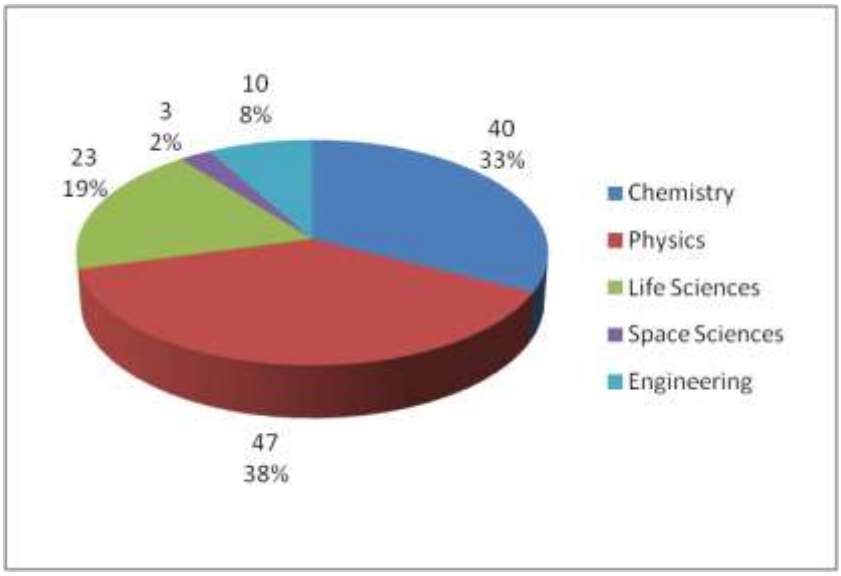


Fig.3. *Local vs external HPC usage*

The figure below shows the openness of national HPC centres towards regional usage, proving the point of collaboration and resource sharing across the borders.

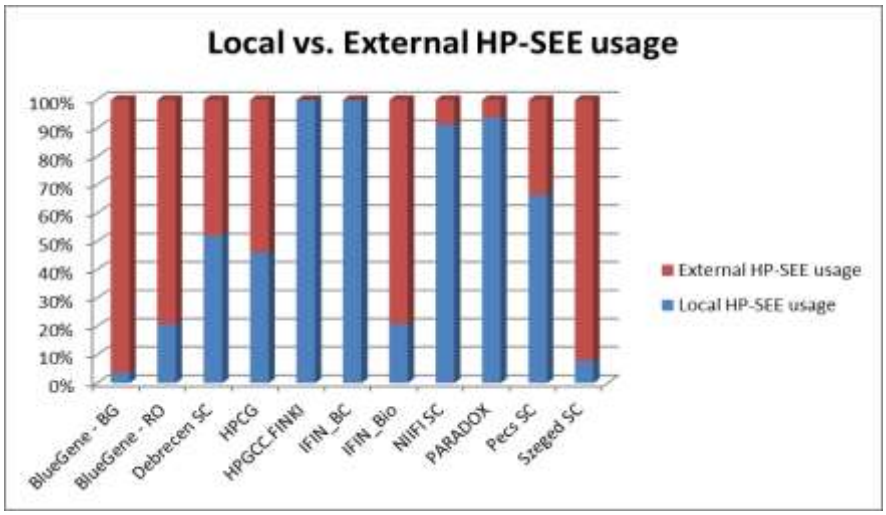


Fig.4. *Local vs external HPC usage*

In order to support the application deployment, the project has collected the current software requirements of the VRC users and the actual software stack of the HPC centres; and further analysed these. The result indicated the requirement for software stacks implemented in collaboration with the HPC centres which are part of the HP-SEE infrastructure. This facilitated improving the harmonisation and interoperability level of the sites. More specifically two software stacks have been proposed. The minimal software stack required to be installed on all sites, while the recommended software stack consists of optional software components that increase the interoperability for application users. HP-SEE Common Environment (HCE) has been created for these software stacks, facilitating the transparent access to the HP-SEE infrastructure based also in the European standards set by PRACE.

On the technology front, the project permanent technology watch activity has been instrumental in the acquiring and spreading of knowledge and technology awareness related to latest trends in HPC. This enabled the gradual adoption of the trends that are mature enough for production level utilization. The open access to most of the acquired material facilitated the distribution of knowledge towards the scientific users not only within the project but also in the interested national communities. The clear technology watch methodology and established processes form a stable basis for the future collaboration within the region in the domain of HPC technologies, which fosters scientific research that otherwise is unfeasible, and facilitates the exchange of knowledge on new HPC technologies strengthening also the national efforts in the domain of HPC.

3.4 Policy developments and soft actions

The coordinated development of national as well as pan-European HPC efforts is key to success for developed countries as well as new EU members and those in ascension / candidate countries. The project objective in this context was to analyse the issues regarding integration and compatibility of and between national HPC infrastructures, regional infrastructures, as well as pan-European infrastructures. Moreover it supports development of coherent national organisational and operational structures.

The project strengthened the technical knowledge and policy background necessary for the maintenance of national HPC initiatives and the creation of HPC centres in the countries of the region, defining and implementing regional collaboration schemes as well as studying the European HPC landscape to identify possibilities for collaboration and knowledge transfer. The Memorandum of Understanding among the partners in the region and modalities on sharing the national resources across scientific disciplines have been signed and actively supported, most notably through the project Pilot Call for new applications requiring access to the regional HPC resources.

The Pilot call also provided means of collaboration with LinkSCEEM-2 project [8], implementing actions related to the expansion of the area of collaboration of HP-SEE to the North-eastern Mediterranean region.

Finally, the project also aimed to further strengthen and widen the regional and national-level Human Network. The project aimed to reach out to as wide as possible range of local and national virtual communities, via strong marketing, dissemination and training campaign.

During its course, the project has organized 37 national level training events and 30 national level dissemination events. Additionally, two regional training events, and one major dissemination event at regional level was

organized in the form of a User Forum. Project and its results have been presented at 27 external events with one or more presentations. HP-SEE User Forum resulted in the book of proceedings published as a special volume of the new Springer series titled "Modelling and Optimization in Science and Technologies"; in total 20 papers were selected for publishing [9] thus demonstrating the high community engagement.

4. Model applicability to the Arab region and beyond: the CHAIN-REDS project

The kind of regional models described in the paper can be expanded to cover collaboration on the truly global level. CHAIN-REDS [10] vision is to promote and support technological and scientific collaboration across different eInfrastructures established and operated in various continents, in order to facilitate their uptake and use by established and emerging Virtual Research Communities (VRCs) but also by single researchers, promoting instruments and practices that can facilitate their inclusion in the community of users. The project aims to support and disseminate the best practices currently adopted in Europe and other continents, and promote and facilitate interoperation and interoperability among different regional eInfrastructures – Grids and other Distributed Computing Infrastructures.

CHAIN-REDS gathers the main stakeholders of regional eInfrastructures, collectively engaged in studying and defining a path towards a global eInfrastructure ecosystem that will allow VRCs, research groups and even single researchers to access and efficiently use worldwide distributed resources (i.e. computing, storage, data, services, tools, applications). CHAIN-REDS is optimizing the interoperation of European infrastructures with those present in 6 regions of the world, both from development and use point of view, and catering to different communities.

The project has produced a set of guidelines how to build and support Regional Operations Centres (ROCs) for Grid computing, and is implementing an action plan for their establishment and support. 6 regions have been identified: Africa (sub-Sahara region), Arabia, Asia/Pacific, China, India and Latin America. These regions are in the process of setting distinct Regional Operations Centres that are responsible for the coordination and management of the operations of the infrastructures. The functionality encompasses authentication and authorization, monitoring, user and operational support, management of Service Level Agreements, helpdesks, etc – all for the final benefit of Virtual Research Communities. The project is also study approaches to the emerging Cloud computing paradigm.

Specifically regarding the Arab region the project has facilitated the creation of a single umbrella ROC (together with sub-Saharan Africa) that coordinates all the activities and that will ensure transfer of knowledge and expertise across the wider region. There are 8 Sites running in production-level within the Africa&Arabia ROC. Alongside the SAGrid (http://www.sagrid.ac.za/) resources of 8 sites, the Grid infrastructure includes the sites from Egypt, Morocco, Algeria, Senegal, Kenya and Tanzania. The ROC's public website is at http://roc.africa-grid.org, and the technical details of AAROC release are at http://aaroc.github.io/releases/AAROC-in-production/ while the ROC blog is at: http://aaroc.github.io/.

5. Conclusions

The HP-SEE project consolidated the process of South-East European regional eInfrastructure development and exploitation by deploying the regional HPC infrastructure, empowering the users and helping the region on the policy level, with the final result being the provision of fully integrated eInfrastructure services on the European level, including the SEE region as a peer. Furthermore, HP-SEE enabled HPC technology adoption in crucial strata of research communities in South-East Europe, especially in the context of the regional-level applications, thus creating a strong bond of researchers across borders and allowing co-ordination of high-quality research in target research fields which benefit from eInfrastructure use.

We believe that this model of regional deployment and operation of computing infrastructures, including Grid and HPC, is applicable to the Arab region – as currently promoted by the CHAIN-REDS project.

6. Acknowledgements

This work has been partially funded by the European Commission Seventh Framework Programme projects: SEE-GRID-SCI (SEE-GRID eInfrastructure for regional eScience); HP-SEE (High-Performance Computing Infrastructure for South East Europe's Research Communities) and CHAIN-REDS (Co-ordination & Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing).

7. References

[1] Natalija Gelvanovska, Michel Rogy, C. M. R. (n.d.). *Broadband Networks in the Middle East and North Africa*. Washington DC 20433: The World Bank.

[2] GEANT http://www.geant.net/

[3] EGI http://www.egi.eu/

[4] PRACE http://www.prace-ri.eu/

[5] SEEREN http://www.seeren.org/

[6] SEE-GRID eInfrastructure for regional eScience, http://www.see-grid-sci.eu/

[7] HP-SEE High-Performance Computing Infrastructure for South East Europe's Research Communities, http://www.hp-see.eu/

[8] Antun Balaž, Ognjen Prnjat, et al., Development of grid e-infrastructure in South–Eastern Europe, Journal of Grid Computing 9 (2011) 135–154.

[9] LinkSceem http://www.linksceem.eu/ls2/

[10] High-Performance Computing Infrastructure for Sout East Europe's Research Communities: Results of the HP-SEE User Forum 2012. Springer series: Modeling and Optimization in Science and Technologies, Vol. 2; Editors: Dulea, M.; Karaivanova, A.; Oulas, A.; Liabotis, I.; Stojiljkovic, D.; Prnjat, O. 2014, X, 171 p. 88 illus., 24 illus. in colour., 20 papers; DOI: 10.1007/978-3-319-01520-0; http://www.springer.com/978-3-319-01519-4

[11] Coordination and Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing, http://www.chain-project.eu/

Author's CV: Dr. Ognjen Prnjat holds the position of European and Regional eInfrastructure manager in the Greek Research and Technology Network. In this role he is responsible for organizing various aspects of computing infrastructures in South-East European region and beyond, their interoperation with pan-European e-Science infrastructure; as well as GRNET involvement in pan-European and worldwide e-Infrastructures. In the past 10 years he has acted as project coordinator for 5 European Commission projects in the field. Previously Ognjen was with the Department of Electronic and Electrical Engineering, University College London, where as a Research Fellow he was leading technical and project management aspects of a number of projects in diverse fields of computing and telecoms. He holds a First Class Honors Bachelor of Eng. Degree in Electronics and Electrical Eng. from University of Surrey, UK; and MSc (Distinction) and Ph.D. in Telecom from University College London.

Surveying Clouds in the Global Environment

Ognjen Prnjat(1), Manuel Rodríguez-Pascual(2), Salem Al-Agtash(3)
(1)*Greek Research and Technology Network*
56, Mesogion Av. – 11527 Athens – Greece
oprnjat@admin.grnet.gr
(2)*Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas 40, Complutense Av - 28040 Madrid - Spain*
Manuel.rodriguez@ciemat.es
(3)*Department of Computer Engineering, German Jordanian University, 11183 Amman Jordan*
Arab States Research and Education Network, GmbH, Dusseldorf Germany
alagtash@gju.edu.jo

Abstract: This paper reports on the results of the survey regarding the Research and Education (R&E) clouds in a number of world regions covered by the CHAIN-REDS project, including the Arab region. The survey includes the technical aspects of R&E clouds, as well as issues related to interoperation, interoperability, compatibility, orchestration and federation. Results obtained show a high interest in standards, thus pointing to the fact that the cloud federation solutions offered by CHAIN-REDS, which include a global cloud federation test-bed and the use of OCCI and CDMI standards, provide a building block for global cloud federated environment.

Keywords: Cloud computing, federations, e-Infrastructure, standards.

1. Introduction

CHAIN-REDS project [1] aims at promoting and supporting technological and scientific collaboration across different e-Infrastructures established and operated in the various continents. It is a FP7 project co-funded by the European Commission and has as ultimate goal to define a path towards a global e-Infrastructure ecosystem that will allow 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).

In CHAIN-REDS line of action regarding "Clouds for Research and Education", the objective is to study cloud compatibility, interoperation, orchestration and federation issues, to provide guidelines for compatibility, and promote interoperation and federability between different clouds initiatives via standards.

In order to understand the state of the art of clouds for R&E in the regions covered by the project (Arab region, Sub-Saharan Africa, Latin America, China, India, Europe), a survey was conducted in early 2014. Main target recipients of the survey were the cloud providers and developers. The only end-users expected to answer it were large institutes, universities, or research groups which use external cloud resources, either public or private. It was not meant for purely research groups experimenting with cloud as a concept, or single end-users.

This paper contains a qualitative analysis of the results of the survey, provides a brief insight in the Arab region specifically, and reports on the relevant issues regarding interoperability, orchestration and federation. The paper concludes with a set of recommendations for cloud federation and use of standards.

2. Survey Design

The first part of the survey focused to obtain high-level vision of what the target recipient considers a cloud infrastructure to be; followed by several questions about the status of cloud infrastructures for R&E. Since one of the main objectives of this survey was to discover the public and private institutions running cloud infrastructures for R&E purposes, several questions about their location, quantity and quality of the resources were asked. Several questions were also asked to gather the technical and managerial contacts of the cloud infrastructures.

The core of the survey then consisted of a series of technical questions about the available resources and their management. For this sake, a group of questions focused on the end-user perspective, and the rest on the provider perspective. The questions for cloud providers covered many issues including economic, user management, middleware, size of the managed resources, accounting, inter-cloud orchestration/federation, security and training.

Fig.1. *Survey snapshot*

The survey has been distributed to the targeted recipients by different means. First, regional representatives have submitted it to the relevant players in their region, such as infrastructure administrators, project managers, etc. In Europe, it has also been submitted to several relevant distribution lists: Spanish National Supercomputing Network, OpenNebula users list, and EGI Cloud Task Force. In Latin America, it has been sent to RedCLARA's SCALAC, NRENs technical responsibles and core computing centres. In Africa, China, Arab region and India, it has been sent both to commercial providers with implications in R&E and to public institutions.

3. Global Survey Results

3.1 Summary of cloud providers for R&E

Cloud Providers

In the field of R&E, the presence in Europe is most noted: currently, there are more than 20 participants in the EGI Federated Cloud [2], more than 35 (including private companies) in Helix-Nebula [3], and 4 European providers in CHAIN-REDS global cloud test-bed [4]. In China, CAS, IHEP and CNGrid are providing cloud computation and storage. In India, several institutions are deploying clouds for R&E, the most important being CDAC [5]. In South Africa, apart from the commercial presence of Microsoft through the UniCloud service, some institutions are slowly building cloud implantations. The rest of Africa and Latin America (apart from Brazil) are the ones with a smaller implantation, although different initiatives are appearing and will hopefully become providers in the mid-term. In the Arab Countries the implantation is also being slow, although Cloud computing services are gradually becoming highly regarded in the R&E sector.

eGovernment and commercial clouds were not the targets of this survey, however some results were collected. In the case of eGovernment, India and Europe have performed significant movements, with public providers offering tools for this purpose. There is however no concrete evidence of clouds for eGovernment in the rest of the regions from the survey. The presence of private companies helps to serve as a reference of the interest on the technology. All regions count with telecom operators starting to provide resources on demand, being mostly employed for web hosting, application development and commodities.

The answers to the survey can be clustered in three groups according to the number of resources. About 40% of them have very small infrastructures, with less than 10 CPUs, not much storage and 2-4 GB memory. These are probably used for testing purposes, or being employed in production on small environments. A second group of about 40-50% has a wider set of resources, with 10 to 100 CPUs, and more storage and memory. These correspond to production environments, where some of the commodities have been migrated to the cloud and resources are being employed by scientists or educators too. The last group of providers, about 10%, are heavy ones. They have environments with thousands of CPUs, storage on different means (disk, tapes) and a lot of memory. These are possibly cloud providers for third parties or administrators of large institutions where a significant part of their infrastructure has been migrated.

Besides questions about their own infrastructures, the survey recipients were asked about other cloud initiatives they are aware of. Results show that, beyond non-commercial R&E clouds, there is a growing interest in the area both by the governments and private companies in all regions.

Cloud Federations

Following the activities on Grid computing, there is an increasing effort towards the federation/orchestration of cloud infrastructures. There are however significant differences between the various continents. The European efforts are evolving towards a stable cloud federation [2], while in Latin America - namely Brazil – same efforts in similar direction are made. In the case of India and China, country-wide institutions (namely CAS and CDAC [6]) are deploying distributed resources, allowing the researchers to access them with standard procedures. Although they are not strictly federations, they are steps in the correct direction.

3.3 Summary of cloud user aspects

The survey showed three different usages of cloud infrastructures for R&E, each representing roughly a third of the users: education, research and commodities.

A group of questions was specifically devoted to determine the friendliness of the solution from the user's point of view. They have indicated that a high knowledge on IT is required, but when you have it, dealing with clouds is not particularly complex, and the existing tools and interfaces do a fairly good job. However, it would be desirable to reduce the need for this technical knowledge.

National data privacy and protection laws have been considered by more than half of the users. A strong relationship between this parameter and the externalization of services is noticeable: the vast majority of the users of external providers have considered data management issues, while people employing in-house solutions do not put so much effort on this, probably because of their trust on their system administrators.

It is important to mention that the employment of outsourced public clouds is still reduced, being usually employed to satisfy peak demands and not very often. That may be probably due to the limited budget on most institutions for cloud infrastructures, and to the fact that both Education and Research - that represent 2/3 of the whole usage - are usually predictable and flexible on their computational demands.

The survey has shown the areas of interest in cloud infrastructures for research. Results show that main interest relies on the areas of bioinformatics, physics, chemistry and engineering. This is not surprising, as those communities are heavy users of distributed infrastructures and have previous experience on Grid computing.

3.4 Summary of technical solutions

The users were asked, both as cloud producers and consumers, about the problems when dealing with cloud infrastructures. The economic problems are identical in both groups. Funding is the main issue, both to hire resources and to pay for the hardware and energy bills. Producers are worried about the sustainability of the cloud model, probably because of the large investment that they have to make in order to be competitive. A particular issue arises: while producers complain about the lack of long-term commitment of users, they complain about the need for long-term contracts.

Other common problems are the ones related to hardware. While there are some specific to the groups (location and maintenance for providers, opacity for users) the most important one is the network. Of course, it worries both groups: the providers must guarantee a high performance network and fluent communication with the servers, while the user is afraid of that not happening, and how to achieve a fair QoS.

When dealing with software, the differences arise. Providers complain about the lack of a clear defined suite of technologies related to building the cloud, fast changing standards, task automation, software deployment and accounting. Users are worried about privacy, security, confidentiality, data movement and vendor lock-in.

These problems are somehow related to standards. There is the need of a clear, universal and well known stack of standards, so the different pieces composing the cloud architecture are interchangeable and stop being a problem. Although these standards do exist, there is still a lack of information that should be addressed in order to speed up the adoption of the cloud paradigm and dismiss both users and providers fears and technological problems.

Last but not least, there were a set of problems related to the human behaviour. Providers pointed at the lack of qualified manpower to build and operate the infrastructures; migration of legacy environments to cloud ones was also –and correctly- pointed as problematic, although this problem will probably be dismissed in the mid-term, as the oldest and more problematic infrastructures are migrated; identity management was seen as a big deal, directly hitting one of the issues that CHAIN-REDS deals with and proposes solutions to, via its identity

federation work; and documentation both for users and administrators was considered a problem too. Also, reticence to change was spotted as a problem by providers too.

Regarding the employed hypervisors, the huge majority of the answers pointed towards Open Source solutions, namely KVM [6] and Xen [7]. A small number of VMWare and hyperV users are also present, showing that there is still room for different paradigms and competitors on the field.

3.4 Summary of management and operational solutions

Next group of questions are related to standards, and clearly reflect two tendencies among providers. About two thirds of them are familiar with OCCI protocol, consider it important and support it in their infrastructures – or are in the process of supporting it. The other third is not really interested in any kind of cloud federation, do not support OCCI and in principle won't do it although all the possible issues are solved. These correspond to private clouds with no interest in scaling or collaborating, and to some public providers in China and India which are partially using their own implementations to handle these issues.

The result of Data Management section shows that about half of the providers that answered the survey provide cloud storage, most of them including CDMI [8] or SWIFT [9]. Other configurations include ownCloud or proprietary systems.

Moving to the operation section, nearly a 90% of the cloud providers employ some kind of monitoring, with about half of them having some kind of accounting mechanism. Regarding the monitoring, the vast majority uses standard existing tools (nagios, Ganglia, OpenNebula monitoring, etc.) although, in the case of accounting, most solutions come from in-house developments.

Regarding standards, most providers are open to the inter-cloud accounting aggregation via APEL SSM 2.0. There is a strong correlation among this parameter and the percentage of accounting usage. There should however be investigated why the rest of providers are reticent to this.

Only about a third of the providers include a Service Level Monitoring (SLA) tool. This probably has to do with the previously proposed usage of the infrastructures, where a 10% of the survey answers were by heavy providers and 30-40% mid-size ones. In this scenario, keeping a SLA is probably out of the scope of most providers.

Authentication and authorization is probably one of the most important sections of the survey. As it has already been stated, dealing with authentication and authorization has been detected as a problem both by cloud users and providers. Thus, knowing what and how the providers are doing is key to finding a suitable solution.

Three quarters of the providers – probably all but the small test installations - use a user registration procedure. In this registration they ask for different authentication ways, depending on the service provider and desired level of security. Standard ones are the name, mail, affiliation and some kind of ID, together with payment information – in case of commercial providers.

At this moment, only about a quarter of the providers are providing some kind of identity federation such as national initiatives or eduGAIN [10]. At last, social web identities (Facebook, Twitter, etc.) are only supported on 20% of the sites. It is important to remark here that several sites reported interest on this or are already testing it, so there is plenty of space to work on this area.

X.509 certificates are supported by half of the providers. Most of them do not implement their own certification authority. Instead, they rely on IGTF Certification Authorities (CAs) or commercial ones. Again, although these stats show a positive tendency, the project should encourage the adoption of this standard certificates and CAs.

The section of Cloud Federation and Information Discovery shows some interesting results. The first noticeable thing is the very positive expectations of the cloud providers towards an intercloud federation: nearly 75% consider publishing their infrastructure information in an inter-cloud context. Slightly over half the providers are already part of some kind of inter-cloud federation, and an additional third in the process of federating or very interest in doing it. Only 10% of the providers are not interested at all in this possibility. The reasons that they claim for this federation cover pretty much all the well-known advantages of the process -performance, reliability, scalability. Surprisingly, virtually all the federated providers distribute the working load manually among the different infrastructures, with no one using a devoted commercial or open software tool.

A similar situation occurs when dealing with GLUE 2.0 and GOCDB. About half the providers know these technologies or are already using it, an additional quarter is interested in them, and the remaining quarter is not interested or does not know the technology. A greater dissemination effort must be made by the affected parts in order to fully reach the community and explain the advantages that these standards provide.

4. Regional Analysis for the Arab Region

This section sheds some light on cloud development in the Arab region, based on survey results collected from a number of existing and potential cloud sites representing research and education infrastructures in United Arab Emirates, Egypt, Jordan, Saudi Arabia and Bahrain – these being the countries, to our knowledge, with some cloud computing developments.

Recently, a growing number of cloud infrastructures have emerged in the Arab World. Cloud computing solutions are still considered as new technologies providing variety of public and private cloud services ranging from hosting applications and services to providing hardware infrastructures. The results of the survey have shown that cloud providers are specifically concentrated in three countries in the Arab Region; United Arab Emirates, Egypt, and Jordan, especially in the telecommunication sector, and this not being directly targeted to the R&E sector.

Telecom operators in these countries are emerging as the main providers of cloud computing and hosting services at enterprise level, covering both small to medium and large companies. This is the case, for example, of Etisalat in the United Arab Emirates (UAE) and Mobily in Saudi Arabia. Cloud services allow a variety of infrastructures to connect to different branches, locally and internationally. The emerging cloud models are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Operators also offer special cloud computing services such as virtual private servers, public clouds or cloud servers, with virtual CPUs, firewall and memory, data transfer or managed storage arrangements. Services also include email hosting solutions, space for information and data storage, co-location of servers, networks and storage equipment, and hosting of research applications.

In contrast, cloud solutions dedicated to R&E are still in their very early stages. The Cloud Computing Lab research initiative at Carnegie Mellon Qatar is an example of those. It aims to advance research and open the cloud infrastructure to local businesses and industries in order to support oil and gas exploration. Ankabut at UAE has begun the negotiation with major cloud providers to setup their own cloud for research and education. IT Synergy has also contributed to setting up cloud infrastructure to support research and education in Egypt. Furthermore, Talal Abu-Ghazaleh has deployed its own private cloud to support universities and research institutions.

Arab Countries			
Inititative	Services	Funding/Access	Country
Electronics Research Institute, Giza and Information Research Institute at Borg El Arab, Alexandria.		Private, public funds	Egypt
Talal Abu-Ghazaleh	IaaS, SaaS	Private. Funded by ASREN	
Arowaad Group	SaaS ERP for Schools	Private	Saudi Arabia
Cloud Computing Lab	IaaS	Private. Funded by Carnegie Mellon University	Qatar
Private Companies			
Orange Jordan	IaaS, PaaS, SaaS	Public	Jordan
Umnia Jordan	IaaS, PaaS, SaaS.	Public	Jordan
TAG Cloud	IaaS, PaaS, SaaS.	Public	Jordan
Etisalat	IaaS, PaaS, SaaS	Public	United Arab Emirates
Mobily	IaaS, PaaS, SaaS	Public	Saudi Arabia

Fig.2. *Cloud initiatives in the Arab region*

Cloud computing services are gradually becoming highly regarded in the R&E sector, with few emerging as part of their NREN developments. However, privacy, security, and reliability concerns represent the main barrier to adopting clouds. Clients are concerned about the use and legacy of their data as well as its confidentiality. As an alternative, private clouds are becoming more popular with their model as host providers for internal use and

limited external use. Users are concerned with data and infrastructure security, as a result, not much information has been revealed in the survey.

It should be noted that responders to the survey did not show much interest in providing details about their infrastructures and solutions (Hypervisor, security solutions, and management and storage). It is intuitively evidenced that the majority of cloud providers in the region rely on VM ware, Microsoft, and Open Source virtualized infrastructures, but not much information can be collected on the percentages of use of these technologies. In conclusion, cloud services in the Arab region are still in the preliminary stages of implementation and will take some time before they are widely deployed and used in a variety of sectors, including research and education.

5. Global Recommendations and Conclusions

In this survey, a thorough analysis of the cloud status for R&E at a global level has been performed.

The results show that, even though there is a very strong interest in cloud computing by the scientific and educational communities, this technology has still not been fully adopted. Based on the resource size and status of the infrastructures, it seems that the infrastructure providers are moving from testbeds to small production environments, slowly solving the administrative and technological issues that the adoption of this new paradigm is arising.

The users were asked, both as cloud producers and consumers, about the problems when dealing with cloud infrastructures. This conclusion section outlines CHAIN-REDS added value regarding these issues and guidelines for the way forward.

Standards: Most of the fears and issues that keep both users and provides away from adoption and use of cloud infrastructures can be solved by a correct deployment of the technology and adoption of standards.

The objective of the CHAIN-REDS cloud activity is 'Promoting and fostering the adoption of standards in R&E eInfrastructures', so we consider that in this respect the current project activity is highly relevant. If the issues worrying the users are corrected through a wise selection of components implementing standards, it will foster cloud adoption, interoperability and cooperation among regions. For this sake, it is important to keep disseminating the importance of standards, together with the creation of a set of guidelines for standards adoption, to orient the infrastructure providers. CHAIN-REDS has provided a set of recommendations for cloud standard usage in Deliverable D3.2 [11]. These include:

• If a region/organisation plans to create a public cloud for research and education and they want to share its computing and storage resources with other clouds available in other parts of the world, for the benefit of the VRCs they support, it is suggested to choose a cloud middleware already supporting the CDMI and OCCI standards.

• If a region/organisation already owns and operates a public cloud for research and education and chosen middleware is not compliant with CDMI and OCCI standards, it is suggested to create the needed services and endpoints to support those standards.

Specifically related to the first point, technical guidelines about how to configure sites in order to be part of the CHAIN-REDS cloud testbed, which is interoperable with the EGI Federated Cloud, are provided in Annexes I, II and III of Deliverable D3.2 [11]. CHAIN-REDS keep these technical guidelines publicly accessible.

As the last point regarding standards, it is important to put special attention on not duplicating efforts, both inside CHAIN-REDS project and among it and other EU-funded ones. Examining the worries of users (privacy, security, confidentiality, data movement and vendor lock-in) and providers (user identification, monitoring, accounting), the work performed within EGI Cloud Task Force is of high relevance for CHAIN-REDS, both in terms of documentation and interoperability results – both effectively adopting a same set of standards.

Global interoperable cloud test-bed: it is important to deploy standards-based, proof-of-principle intercontinental cloud federations, to be able to demonstrate the feasibility of such cloud federations on a global scale.

CHAIN-REDS will continue its efforts on building an intercontinental interoperable cloud, fully based on standards, as proof-of-principle of cloud orchestration and federation. Currently, the CHAIN-REDS test-bed consists of a total of 10 sites, including a number of European sites, an Egyptian site from the Arab region, and, following up on survey results one site from South Africa has been also successfully integrated after being provided with CHAIN-REDS standards and guidelines. 4 of the 10 sites are also belonging to the EGI Federated Cloud and 3 different and well known cloud stacks are supported, namely Okeanos [12], OpenNebula [13] and OpenStack [14].

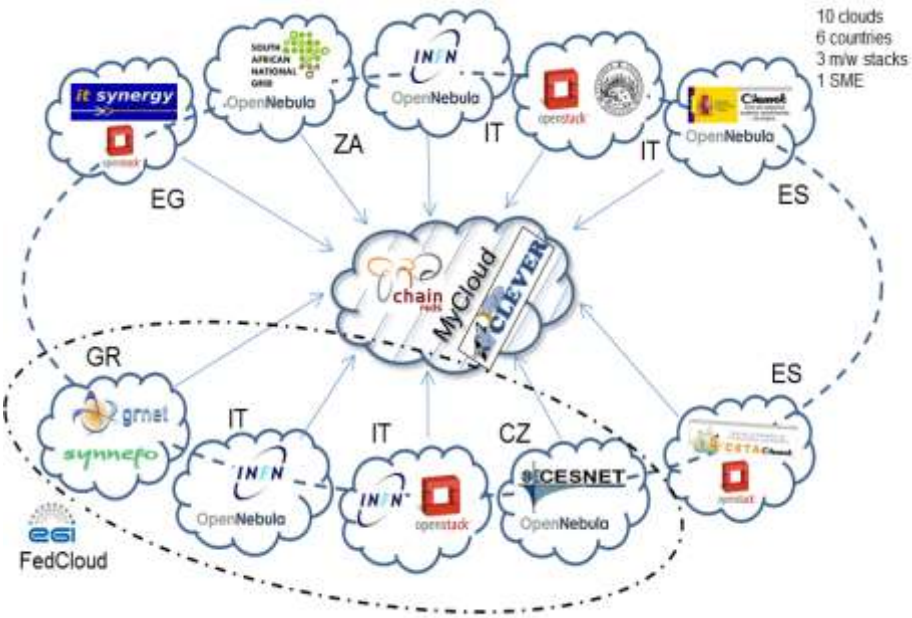


Fig.3. *CHAIN-REDS cloud testbed*

Efforts will be invested in further dissemination of CHAIN-REDS adopted standards to ensure proof-of-principle global coverage. The potential sites pinpointed by the survey (and not yet fully members of the demo will be contacted on technical and managerial levels), so collaboration can be established and some resources potentially integrated. This way, these flagship institutions will serve as an entry point in their communities.

Ease of access (authentication and authorisation): this is one of the crucial factors and as such should be a priority in stand-alone as well as federated cloud environments.

Regarding this aspect, CHAIN-REDS approach to Identity-Federation based access is directly relevant, with eduroam is being adopted both on the European level, while the rest of the world regions involved in CHAIN-REDS are being exposed these concepts by the project. This approach should continue being promoted: at the moment only about a quarter of the providers are providing some kind of identity federation such as national initiatives or eduGAIN [10]. On the other hand, X509 certificates are supported by half of the providers; most of them do not implement their own Certification Authority and instead rely on IGTF CAs or commercial ones. Again, although these stats show a positive trend, and the project should also encourage the adoption of this standard certificates and CAs.

Documentation and training: documentation and training on cloud computing is of high importance to ensure the take-up of the technology and overcome the adoption barrier.

The problems related to user and administrator formation, as well as the technology dissemination, are necessary to be tackled. For this sake, valuable documentation has to be created or located, and offered on a single entry point –such as the project web- so it can be employed at different levels: administration reference, academic formation and so. Members of CHAIN-REDS project, fully aware of this problem, are working together with the EGI Federated Cloud on creating documentation regarding these scenarios, so it can be used as a reference in both projects. Also, as stated, one of the main uses of the cloud infrastructures is the academic one. This has to be surely seen as an opportunity to promote the use of standard technologies and identification. System administrators and decision makers should be made aware of importance of the use of standard technologies as a way of offering the widest possible set of resources with the minimum effort.

Overall, if standards are promoted, proof-of-principle deployments created, security and ease of access enhanced, identification simplified and documentation improved, users will stop seeing the cloud as a problem and start seeing it as a solution.

6. Acknowledgements

This work has been partially funded by the European Commission Seventh Framework Programme project CHAIN-REDS (Co-ordination & Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing).

7. References

[1] Coordination and Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing, http://www.chain-project.eu/

[2] https://www.egi.eu/infrastructure/cloud/

[3] http://www.helix-nebula.eu/

[4] https://www.chain-project.eu/cloud-testbed

[5] http://cdac.in/

[6] http://www.linux-kvm.org/page/Main_Page

[7] www.xenproject.org/

[8] http://www.snia.org/cdmi

[9] https://wiki.openstack.org/wiki/Swift

[10] http://www.geant.net/service/eduGAIN/Pages/home.aspx

[11] CHAIN-REDS deliverable D3.2, "Interoperability guidelines and design" http://documents.ct.infn.it/record/563/files/CHAIN-REDS-D3.2_v0.6.pdf

[12] https://okeanos.grnet.gr/home/

[13] http://opennebula.org/

[14] http://www.openstack.org/

Author' CVs: Dr. Ognjen Prnjat holds the position of European and Regional eInfrastructure manager in the Greek Research and Technology Network. In this role he is responsible for organizing various aspects of computing infrastructures in South-East European region and beyond, their interoperation with pan-European e-Science infrastructure; as well as GRNET involvement in pan-European and worldwide e-Infrastructures. In the past 10 years he has acted as project coordinator for 5 European Commission projects in the field. Previously Ognjen was with the Department of Electronic and Electrical Engineering, University College London, where as a Research Fellow he was leading technical and project management aspects of a number of projects in diverse fields of computing and telecoms. He holds a First Class Honors Bachelor of Eng. Degree in Electronics and Electrical Eng. from University of Surrey, UK; and MSc (Distinction) and Ph.D. in Telecom from University College London.

Dr. Rodriguez is a Research Fellow at CIEMAT, where he has been working for the last 6 years. There, he has been involved in 8 European and 4 National projects, where he has held different levels of responsibility. His experience lays on the area of distributed computing, especially in heterogeneous systems, fault tolerance and dynamic task scheduling. He holds a PhD in Computer Science, MSc in Computer Research and MSc in Computer Engineering, all by the Universidad Complutense de Madrid.

Dr. Al-Agtash got his Ph.D. in Electrical Engineering from the University of Colorado at Boulder in 1998. He is a professor of Computer Engineering at the German Jordanian University and leading the development of the Arab States Research and Education Network in his capacity as the Chairman's Senior Advisor on ICT and Technology. His experience is in the area of academic research, teaching, consulting, and development. His research focuses on Electric power industry, Scheduling Mechanisms, Agent Systems, Artificial Intelligence, Software Design, Smart grids, ICT Infrastructure, Industrial linkages, Education, and Innovative partnership.

The Pamphagidae (Orthoptera) from East Algeria and Description of a New Species

NAIMA BENKENANA[(1)], ABBOUD HARRAT[(1)], DANIEL PETIT[(2)]

[(1)] *Laboratoire de Biosystématique et Ecologie des Arthropodes, Université Constantine 1, route d'Aïn-El-Bey-25000, Constantine, Algérie. E-mail: naima_benkenana@yahoo.fr, abboud52@yahoo.fr*

[(2)] *UMR 1061 INRA, Université de Limoges, 123, av. A. Thomas, 87060 Limoges Cedex, France. E-mail: daniel.petit@unilim.fr*

Abstract: Through a 3-year survey of 9 stations in North East of Algeria, we recorded 16 species of grasshopper belonging to the family Pamphagidae. The National Park of Belezma, near Batna city, appears to be the richest region for this family, with 10 species. Notably, Paracinipe sulphuripes, only known from Djelfa, is present at Belezma, showing unexpected relationship between these two areas, separated by 280 km. Within the Pamphagus djelfensis complex, a new species is described, P. batnensis Benkenana & Petit, easily distinguishable by its epiphallic characters. Taking into account several studies dealing with other Algerian stations, we provide certain climatic constraints of most species, as illustrated by bioclimagrams. We show that the semi-arid stage with fresh winter and sub-humid stage with cold winter correspond to the most suitable conditions for this family.

Key words: Pamphagidae, Pamphagus, Belezma, Algeria

1. Introduction

Pamphagus elephas and *P. cristatus* were first described by Linneaeus (1758) under the genus *Locusta*. These species, and further discovered ones, are now classified in the Pamphagidae Burmeister, H. 1840, a family divided into 8 subfamilies, according to Orthoptera Species File (Eades et al. 2011). Following Harz (1975), this family differs from other Acridomorpha by its head being never conical, the vertex forming with the front a right or obtuse broadly rounded angle, and with foveola, if distinct, always separated. Moreover, the second segment of abdomen bears Krauss'organ, with oblique stripes, in winged species and Pamphagus. There is a dorsal apical spine at the outside of hind tibia. The epiphallus is shield-like, with ancorae and without lophi. The mechanism of sound production differs in the different genera. In Tmethis, the stridulation can occur during the flight, due to the dentated middle tibia against the modified venation of hind wings. In *Euryparyphes sitifiensis*, Korsakoff (1941) described a sound production by the mesothoracic legs against tegmina. In Pamphagus and several genera within Pamphaginae, there is a mechanism more used by females than by males, consisting in tegmina strokes against the vestigial hind wings stuck onto the metanotum (Johnsen 1972,Massa & Lo Verde 1990). Another stridulatory mechanism in several species of Pamphagus involves the movement of hind femora, especially when the temperature increases. The sound produced by the males is louder than that of the females (pers. observation). Several authors mentioned the long duration of copulation (between 1 and 10 h in the genus Pamphagus), in relation with the fertilization of a large number of oocytes that will be laid in each egg-pod (between 100 and 400) (Massa & Lo Verde 1990).

The first entomologists interested in Algerian Pamphagidae were Lucas (1851) and Brisout de Barneville(1850). Later, Vosseler (1902) and others continued to describe new species. The first synthesis of North African Pamphagidae was undertaken by Chopard (1943), followed by Descamps and Mounassif (1972), and more recently by Massa and colleagues (from 1987 to 1996). As some Pamphagidae species are pests against crops in Algeria, as Ocneridia volxemi, several theses dealing with Acridomorpha were directed by Professors Doumandji and Doumandji- Mitiche (Benfekih, 1998; Benmadani, 2010; Guendouz-Benrima et al. 2011). However, if we exclude O. volxemi (Fellaouine, 1984), most Pamphagidae species were rather neglected because of difficulties in identification. As shown by Descamps and Mounassif (1972), the examination of male genitalia is not dispensable, due to the absence of available venation characters in the tegmina of most species, which are apterous.

Although the diversity of Pamphagidae is recognized as high in North Africa since the work of Korsakoff (1941) and Chopard (1943), this group remains rarely studied. La Greca (1998) proposed an interesting hypothesis explaining the richness and originality of this fauna in the West Mediterranean Basin. From populations settled in the African part of Gondwana, the northward drift of terranes across the Tethys carried several lineages belonging to the ancestors of Pamphaginae and Prionotropisinae during Mesozoic and early Cenozoic. In the same time, other terranes migrated toward a more eastern part of Eurasian plate, and reached the region near Afghanistan and Iran. These stimulating ideas have now to be tested with a molecular approach dealing with the phylogeny of entire family, as initiated by Zhang et al. (2005).

The aim of the present work was to collect numerous specimens of Pamphagidae in several stations from North East Algeria, with a systematic dissection of male genitalia. The determination of females in the case of critical species was limited to individuals kept in copula. These data were found to be useful to describe some climatic constraints on their presence, and to evidence the most interesting stations.

2. Material and methods

Choice of study stations. In order to collect the maximum number of species, we explored numerous stations in north east Algeria, varying by their altitude, climatic stage and vegetation. Among these stations, we retained the specimens of Pamphagidae species from nine richest stations (fig. 1). In previous studies (Benkenana 2006, Benkenana and Harrat 2009), we observed that in the area of Constantine, Ocneridia volxemii (Bolivar, 1878) was the only species recorded during summer and autumn as adults. Otherwise, with field study sessions with the students of Mentouri University, organised in different localities in spring and in the beginning of autumn, we observed that most activity of Pamphagidae species was developed in spring. Thus, during the 3 year-survey, each station was visited 8 times between the months of March to June. Collo station is situated in the Mediterranean humid stage, whereas others are in the semi-arid or sub-humid stages. The altitudes range from 43 m at the Mediterranean coast near Collo, to 1142 m in the station of Khenchela Wilaya, and most stations are above 580 m A.S.L. The vegetation is composed of steppe, pastures, fallow land and crops.

For each day of sampling, each station was explored for three hours between 10 and 14 h, corresponding to the peak of activity of adults, on a surface between 500 and 1000 m². The insects were collected using a sweeping net, then kept in a plastic jar, and further stored in freezer at -17°C in the laboratory. The abdomen of females was first dissected to remove the ooocyte content, stored in eppendorf tubes with 70% alcohol. The specimens were preserved in display boxes with a label indicating the station, date and record number. The phallic complex was dissected following the technique of Amédégnato (1976), in males softened in hot water, lightened in a 50 % KOH solution, and kept in Eppendorf tube with 70% alcohol. The females observed in copula were assigned to the record number of their mating male. The determinations were conducted using the keys included in Chopard (1943), Biondi & Massa (1995), Massa & Cusimano (1979), Massa & Biondi (1987), Massa & Lo Verde (1990), Massa et *al*. (1993), and Massa (1992, 1996). The names followed the nomenclature adopted by OSF2 (http://Orthop- tera.SpeciesFile.org). The plant specimens were also collected to be determined in the laboratory, using Quézel & Santa (1962–1963), and the nomenclature was updated with Tela-Botanica (http://www.tela-botanica.org). Plant and insect specimens are vouchered at the Laboratoire de Biosystématique et Ecologie des Arthropodes (Mentouri University) and in the zoology collection of Limoges University.

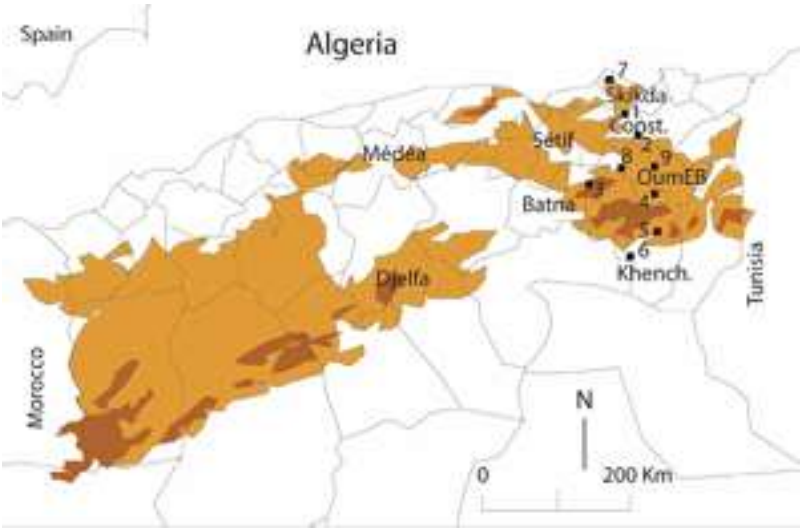


***FIGURE 1**. Distribution of the 9 study stations. The areas between 0 and 1000 m A.S.L. are in white, between 1000 and 1500 m in light colour, and more than 1500 m in darker colour.*

Climatic data were gathered from the Meteorological Stations of each Wilaya, specifically the means for Setif Wilaya (1972–1987), Medea Wilaya (1987–1992), Djelfa Wilaya (1977–2006), Oum-elBouaghi, Skikda and Constantine (1984–2004), Batna Wilaya (1989–2009), and Khenchela Wilaya (1999–2009). The calculation of precise values for each station was interpolated from the nearest town's data, according to Seltzer (1946). Briefly, temperature declined 0.6° C, and annual rainfall increased by 50 mm for 100 m increase in altitude. For morphometric analyses, we recorded quantitative parameters (length and height of hind femur, pronotum, ventral part of thorax, head, and length of abdomen). In the case of male genitalia, we also measured the echinule number on epiphallus, the divergence angle between both echinule series, valve height and phallic complex length. The most appropriate multivariate analysis is a Principal Component, a technique that allows visualizing

on a single plane the correlations between these parameters, indicated by orientation and length of vectors: the more acute the angle, the stronger the correlation. Otherwise, each specimen is also plotted on the same plane, and then assigned to a special taxon if the collections of points are well grouped. It is possible to verify the homogeneity of taxa by drawing a dendrogram based on the Euclidian distances calculated from the 3 first scores. All these procedures were conducted using PAST 2.08 (Hammer et al. 2001).

The distribution of each species was detemined from the works of Chopard (1943), Maurel (2008), and the collections kept in the Muséum National d'Histoire Naturelle de Paris (MNHN). The maps, limited to the North-East of Algeria, were drawn using Adobe illustrator CS4. The climagrams, in the sense of Emberger-Sauvage, are particularly suitable to define the climatic constraints on Mediterranean terrestrial organisms (Sauvage, 1963), and they take into account the minima means of the coldest month (m, in °C), maxima means of the hottest month (M, in °C), annual rainfall (P, in mm), and Q2, with Q2 = 3.43 (P/M-m). The climagrams were drawn with SYSTAT 7.0 (SPSS, 1997), following the method used in Benfekihet *al.* 2011.

3. Results

We collected a total of 691 specimens, belonging to 16 species of Pamphagidae, divided into three subfamilies: Pamphaginae (*Pamphagus*, *Ocneridia*, *Paracinipe*, *Paraeuryparyphes*, *Euryparyphes*), Orchaminae *(Acinipe*), and Prionotropisinae (*Tmethis*).

4. Checklist of species

Ocneridia volxemii (Bolivar, 1878). It was the most frequent species, which was present in 24 stations over 33, with the broadest altitude range, from 43 m to 1300 m. It seemed to be absent below the 35th parallel (fig. 2A), as well as the two following species of the genus. This species was mostly found in semi-arid, sub-humid, and humid stages, when m was less than 6°C (fig. 3A). The adults were observed from the second fortnight of April to the end of June.

Ocneridia nigropunctata (Lucas, 1849). This species was only encountered in the Wilaya of Constantine, Batna, Oum-el-Bouaghi and Khenchela, at altitudes between 476 m and 1200 m (fig. 2B). The bioclimagram of this species was identical to the previous one (fig. 3B). The adults were observed from mid-April to mid-June.

Ocneridia microptera (Brisout, 1851). This rare species was recorded in the two stations of Constantine Wilaya,and 2 stations of Setif Wilaya, between 476 m and 950 m (fig. 2C). The frequency of this species peaked insub-humid and semi-arid stages with m between 2 and 4 °C, and less than 0°C. We can conclude that O.microptera needs more arid conditions than the first 2 species (fig. 3C). The adults were observed from the second fortnight of May to the first week of June.

Paraeuryparyphes quadridentatus (Brisout, 1852). Tidisse, near Constantine, is the only station close to 500 m where this species was found. The altitude of the other stations is above 1000 m (fig. 2D), as at Belezma, two stations in Djelfa Wilaya and El-Benia (Medea Wilaya). This species was frequent in semi-arid stage with m between 3 and 5 °C and in sub-humid stage with m between -1 and -3°C (fig. 3D). The adults were only observed in May.

Euryparyphes sitifensis (Brisout, 1854). This rare species was localized at Belezma and in the three stations of Djelfa Wilaya, at altitudes between 874 m and 1214 m (fig. 2E). We do not understand why this species was not noted in the work of Fellaouine (1989) who explored Setif Wilaya in detail (*locus classicus*). In contrast to the previous species, *E. sitifens*is was mostly found in semi-arid and arid stages with m around 0°C (fig. 3E). We observed adults from the end of April to mid-May.

Tmethis pulchripennis algerica Saussure, 1888. The three stations explored by Benmadani (2010) in Djelfa Wilaya contained this taxon. In our study, this species was also found in Belezma National Park, and Mlila (fig. 2F). The altitudes are between 780 and 1214 m. This species showed the same climatic constraints as the previous one (fig. 3F). We observed adults from May to mid-June.

Tmethis cisti cisti (Fabricius, 1787). This species was found in Belezma National Park, and Mlila, near a sebkha,i.e. an area with salted soil. It was previously recorded in 7 stations/19 from Setif Wilaya (Fellaouine, 1989) and at El-Benia in Médéa Wilaya (Benfekih, 1998) (fig. 2G). The altitudes range from 780 m to 1300 m. This species was mostly found in semi-arid and arid stages when m is less than 0°C (fig. 3G). The phenology of adults was similar to the previous species.

Pamphagus cristatus Descamps & Mounassif, 1972. This species had a restricted distribution, present in Oum-el-Bouaghi Wilaya, but frequent at Collo (Skikda Wilaya) (fig. 2H). The altitudes vary between 43 and 1000 m.

This species needs mild winter temperature, with m above 5°C (fig. 3H). In Collo, adults were observed from the end of March to mid-June, but in May only in Oum-El-Bouaghi.

Pamphagus elephas (Linn, 1758). It was the most frequent species for the genus, with 7 localities, and the broadest altitudinal distribution, from 43 m to 2000 m. Even if older records are taken into account, the distribution is above the 35th parallel (Fig. 2I). It preferred more humid vegetation than the other species of the genus. This species had a wide bioclimatic amplitude, from the humid stage with m less than 0°C until the semi-arid with m above 6°C (fig. 3I). In Collo and Oum-El-Bouaghi, the adults were observed in May.

Pamphagus marmoratus Burmeister, 1838. It had almost the same distribution as P. elephas, and the same altitudinal range (fig. 2J). As a result, we observed the same bioclimagram as for P. elephas. The adults were observed in May in Collo, Ain-Mlila and Oum-El-Bouaghi.

Pamphagus auresianus Massa, 1992. This species was localized in Monts des Aurès, in Khenchela and Batna Wilaya, between 980 and 1200 m (fig. 2K). This species lived in areas under humid and sub-humid stage, with m less than 0°C (fig. 3J). We observed adults from the last week of April until the first week of June in Belezma, but from the end of March to the end of May in El-Hamma station. The foraging and reproduction activities were observed in the hottest hours of the day. The mating could be observed on the ground or on herbaceous vegetation as Stipa tenacissima. It lasted at least 2 hours and several couples kept in jars were retrieved the next day still in copula.

Pamphagus batnensis nov. sp. Benkenana & Petit. This species belonged to the complex *P. djelfensis* and was found at Belezma (Batna Wilaya) and El-Hamma (Khenchela Wilaya) (fig. 2L). This species shared the same climagram as *P. auresianus*. The phenology of adults was similar to the one observed in *P. auresianus*.

Pamphagus djelfensis Vosseler, 1902. The station of Belezma was unexpected as this taxon was described from Djelfa. Moreover, we do not understand why Benmadani (2010) did not found this species in his study sites near Djelfa (locus classicus) (fig. 2M). This species also had a similar bioclimagram as both previous species (fig. 3K). The phenology of adults was similar to the one observed in *P. auresianus*.

Acinipe calabra (Costa, 1836). This species was found near the sea level, at Collo, up to 1214 m in Djelfa Wilaya at Moudjebara. It was also found in Constantine Wilaya, and Medea Wilaya at Ain-Sefra (fig. 2N). This species was mostly found in areas under arid and semi-arid stage, with m above 4°C (fig. 3L). The adults were observed in May.

Paracinipe saharae (Pictet & Saussure, 1893). This species was abundant in Khirane at 584 m, but rare in Babar at 1140 m (fig. 2O). This species had a large bioclimatic amplitude, and was particularly frequent in arid stage with m above 4°C, but it could also be found in humid stage with m less than 0°C (fig. 3M). The adults were observed from the end of March to the end of May.

Paracinipe sulphuripes (Uvarov, 1942). This species, only known from Djelfa area (Massa, 1996), was discovered for the first time in Batna Wilaya, at Belezma, at an altitude of 1200 m (fig. 2P). This suggests that the isolation between *P. sulphuripes* and *P. saharae* might be due to altitude and not to distant areas. As *P. sulphuripes* was poorly known, we provided comparative measurements, indicating that the values were smaller in this species than in *P. saharae*, particularly for phallic complex (fig. 4). This species preferred humid and subhumid stages, with m less than 1°C. The adults were only found from the end of May to mid-June.

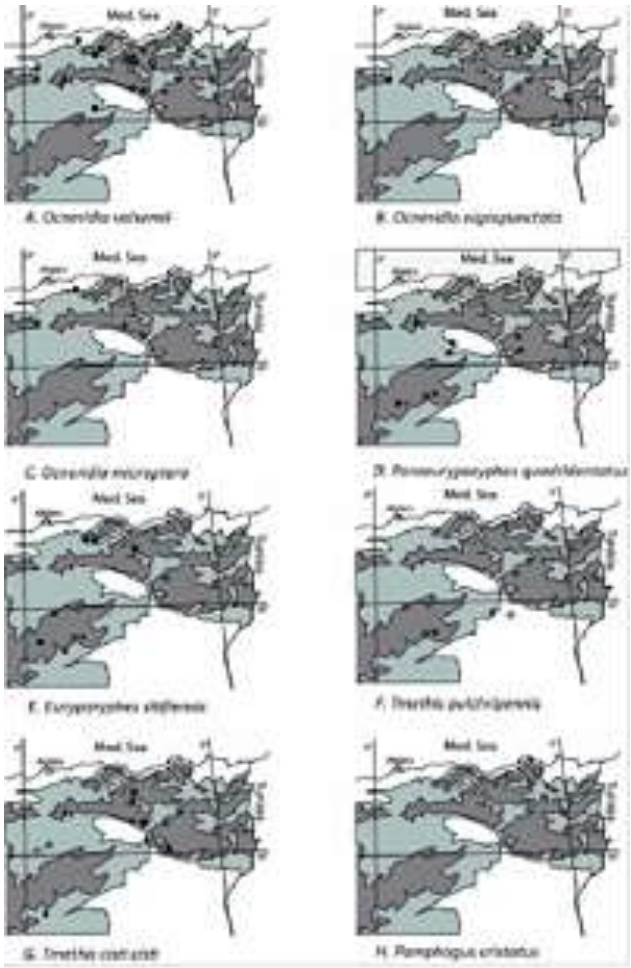


FIGURE 2a. *Distribution map of the species. Recent observations (>1980) were indicated by a wide circle, and older ones (<1960) by a black circle. The areas between 0 and 500 m A.S.L. are in white, between 500 and 1000 m in light grey, and more than 1000 m in dark grey*

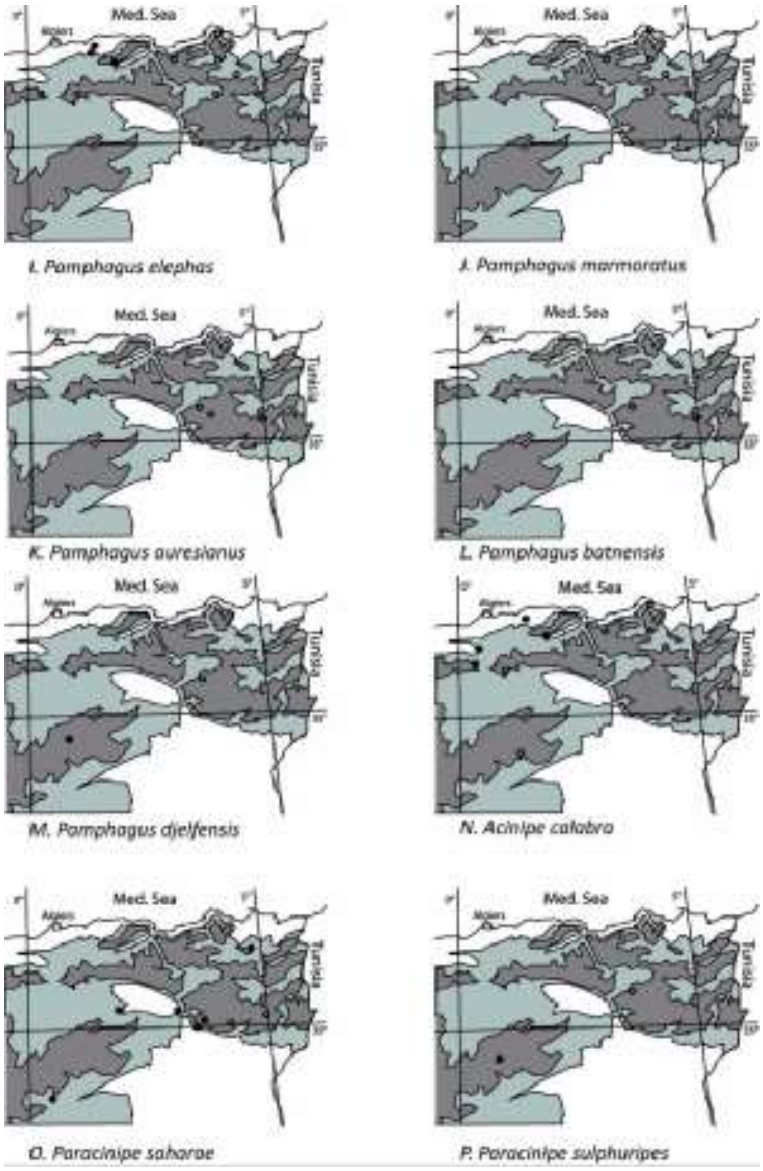


FIGURE 2b. *Distribution map of the species. Recent observations (>1980) were indicated by a wide circle, and older on (<1960) by a black circle. The areas between 0 and 500 m A.S.L. are in white, between 500 and 1000 m in light grey, and more than 1000 m in dark grey.*

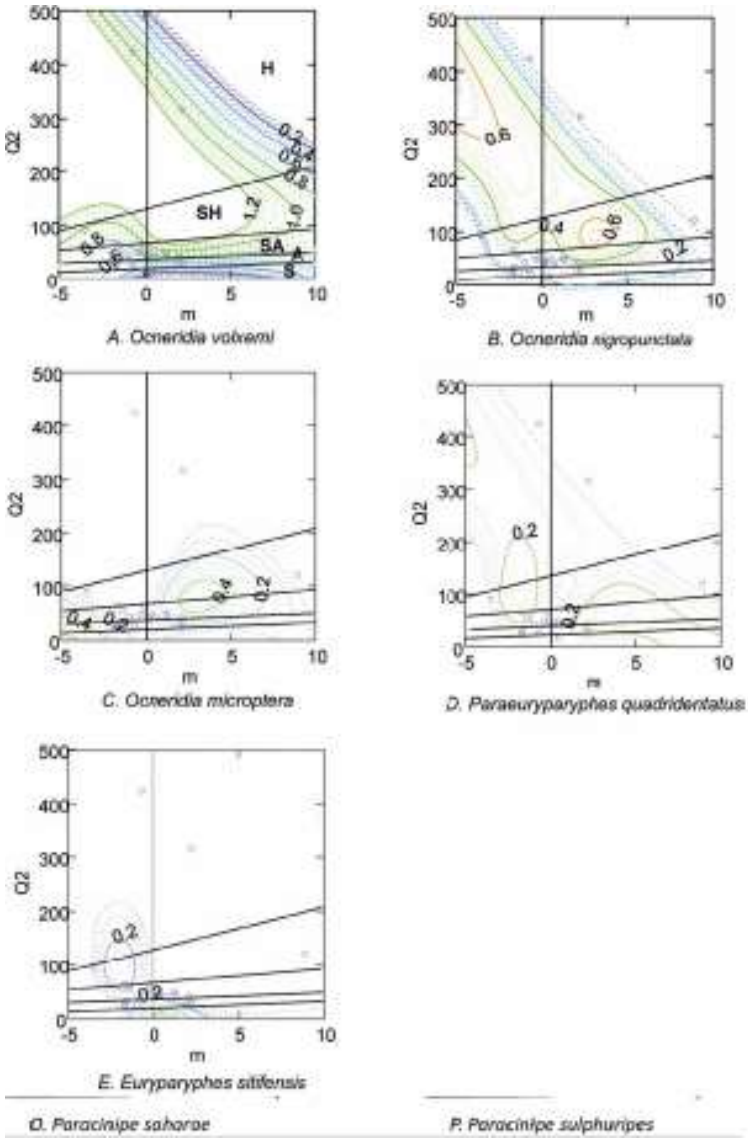


FIGURE 3a. *Climagrams of species. m = temperature minima means of the coldest month; Q2= 3.43 P/(M-m), see the text; S = Saharian stage; A = arid stage; SA = semi-arid stage; SH = sub-humid stage; H = humid stage. A: O. volxemii; B: O. nigropunctata; C: O. microptera; D: P. quadridentatus ; E : E. sitifiensis ; F : T. pulchripennis ; G : T. cisti ; H: P. cristatus; I: P. elephas/ marmoratus; J: P. auresianus/batnensis; K: P. djelfensis; L: A. calabra; M: P. saharae; N: P. sulphuripes.*

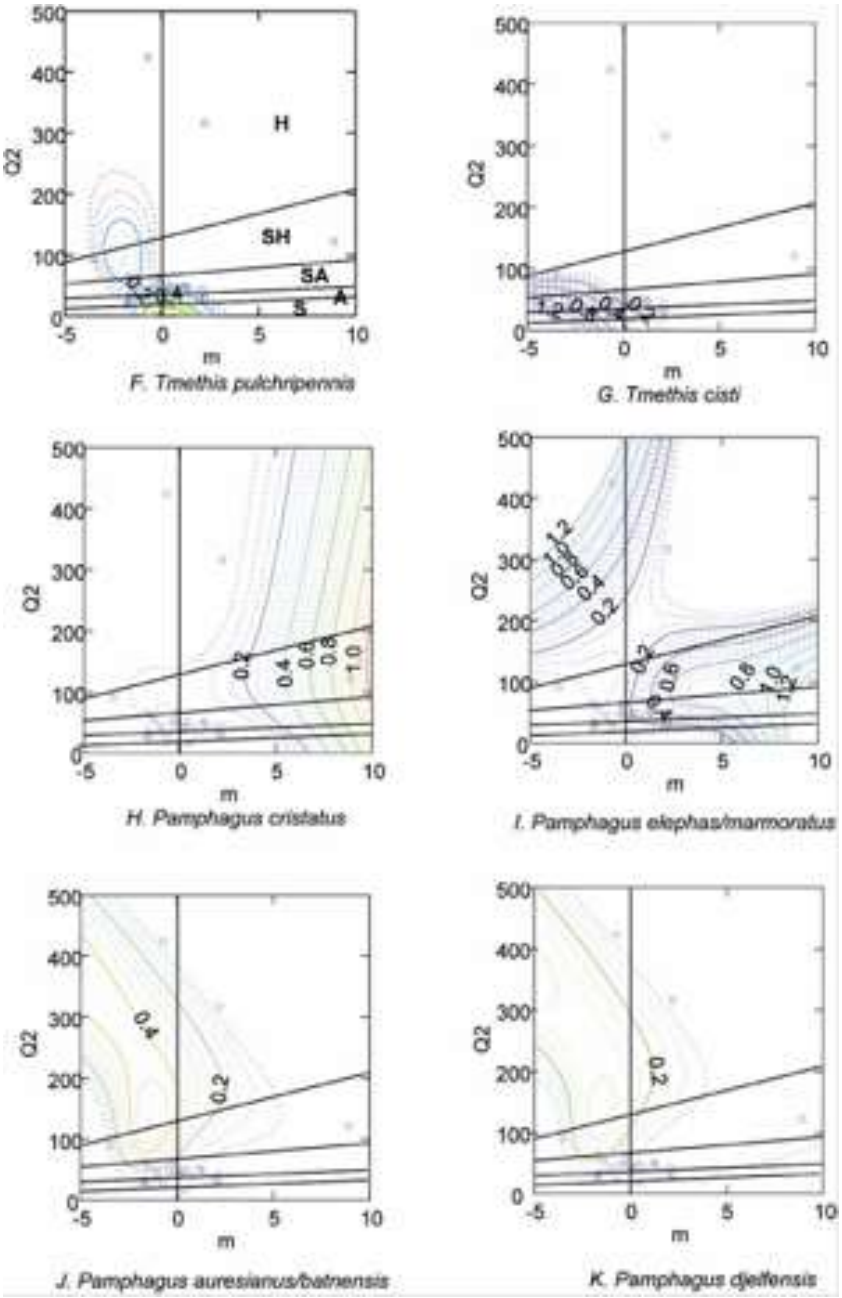


FIGURE 3b. *Climagrams of species. m = temperature minima means of the coldest month; Q2= 3.43 P/(M-m), see the text; S= Saharian stage; A = arid stage; SA = semi-arid stage; SH = sub-humid stage; H = humid stage. A: O. volxemii; B: O. nigropunctata; C: O. microptera; D: P. quadridentatus ; E : E. sitifiensis ; F : T. pulchripennis ; G : T. cisti ; H: P. cristatus; I: P. elephas/ marmoratus; J: P. auresianus/batnensis; K: P. djelfensis; L: A. calabra; M: P. saharae; N: P. sulphuripes.*

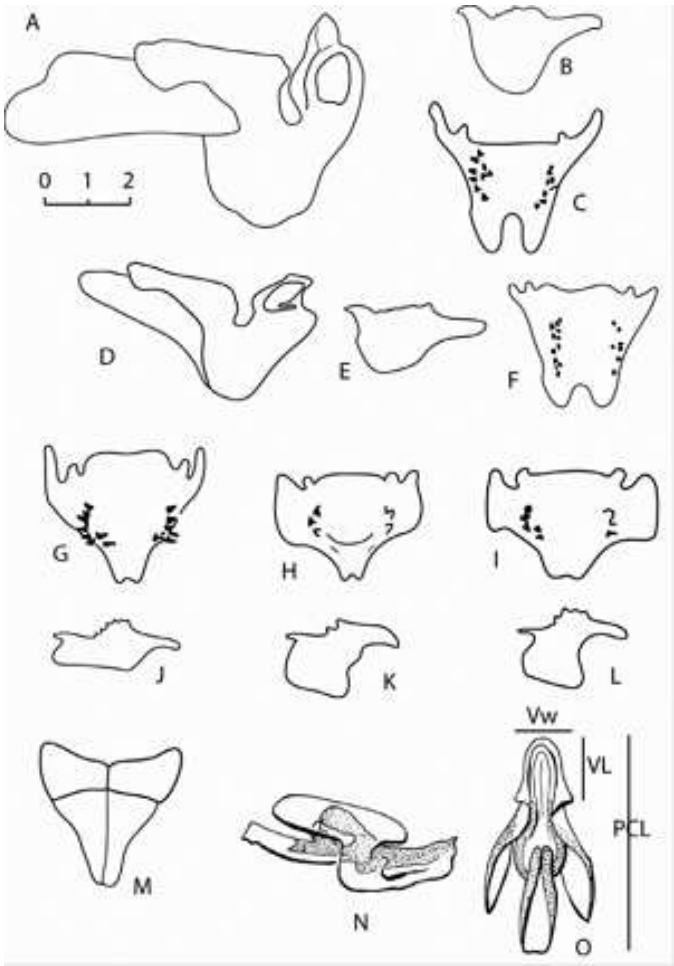


FIGURE 4. *Genitalia of Paracinipe of the saharae group and of Pamphagus djelfensis complex. A, B, and C: genitalia of P. saharae; A: Phallic complex, lateral; B: epiphallus, lateral; C: epiphallus; D, E, and F: genitalia of P. sulphuripes; D: Phallic complex, lateral; E: epiphallus, lateral; F: epiphallus; G and J: Pamphagus djelfensis; H, K, M, N and O: P. batnensis; I and L: P. auresianus; G, H, and I: epiphallus; J, K, and L: epiphallus, lateral; M: ventral valves of females; N: lateral profile of phallic complex, epiphallus removed (paratype 21K kept in Limoges University); O: ventral profile of phallic complex (paratype 21K kept in Limoges University). The scale is identical for all drawings. Vw: valve width; VL: valve length; PCL: phallic complex length.*

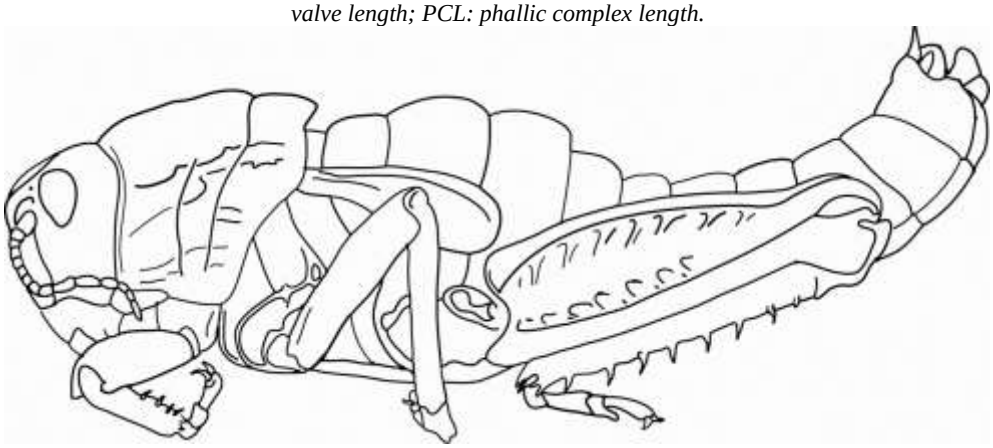


FIGURE 5. *Pamphagus batnensis, holotype male, lateral.*

5. Conclusion

Among the 25 species recorded in Algeria, including the new described one, 16 were present in East Algeria. Our work stresses the species richness of Belezma National Park, sheltering 10 species. The studied station is a nondegraded steppe with Stipa tenacissima and Artemisia herba-alba, at an altitude of 1200 m. Among the three areas constituting this Park, two remain to be explored, and new taxa are expected to be found for the region.

Our findings are surprising because it was thought that in the genus *Pamphagus*, the distribution was disjointed between the different species. For example, Massa (1992) and Massa et al. (1993) claimed that *P. djelfensis* and

P. auresianus were vicariant species, one in Djelfa area, and the other in Monts des Aurès. It was the same for *P. elephas*, in the north center of Algeria, and *P. cristatus*, a more oriental taxon. Our samplings during three years allowed a new hypothesis, and the limits of distribution maps are larger than previously found. Moreover, the different species do not seem to follow a vicariance model. Of course, genetic data could provide useful information to test our hypotheses.

We conclude that several Pamphagus species coexist at Belezma, even in the *P. djelfensis* complex. Our approach to define the bioclimatic constraints, taking into account vegetation parameters, could bring some important considerations to understand the isolation between the species of this complex.

6. References

[1] Aiouaz, M., Boufersaoui, A. (1973) Cycle biologique et croissance morphométrique de Pamphagus elephas (L.). Bulletin de la Société d'Histoire naturelle d'Afrique du Nord, Alger, 64, 39–50.

[2] Amedegnato, C. (1976) Structure et évolution des génitalia chez les Acrididae et familles apparentées. Acrida, 5, 1–16.

[3] Benfekih, L. (1998) Données préliminaires sur la bioécologie de la sauterelle marocaine Dociostaurus maroccanus (Thunberg, 1815) (Orthoptera, Gomphocerinae) dans la région d'Ain Boucif. Thèse de Magister en Agronomie. Institut National Agronomique El-Harrach, Alger.

[4] Benfekih, L. & Petit, D. (2010) The populations of Locusta migratoria cinerascens (Orthoptera: Acrididae: Oedipodinae) in Algerian Sahara: life cycle. Annales de la Société Entomologique de France, 46 (3–4), 351–358.

[5] Benfekih, L., Foucart, A. & Petit, D. (2011) Central Saharan populations of Locusta migratoria cinerascens (Orthoptera: Acrididae) in irrigated perimeters: is it a recent colonisation event? Annales de la Société Entomologique de France, 47(1– 2), 147–153.

[6] Benkenana, N. (2006) Etude biosystématique et quelques aspects bio-écologiques des espèces acridiennes d'importance économique de la région de Constantine. Thèse de Magistère, Université Mentouri, Constantine.

[7] Benkenana, N. & Harrat, A. (2009) Contribution to the systematic study of grasshopper fauna (Orthoptera, Caelifera) and some bio-ecological aspects of economic importance of species in the Constantine region (Eastern Algeria). Emirate Journal of Food and Agriculture, 21(1), 40–47.

[8] Benmadani, S. (2010) Biosystématique des Orthoptères de la région de Djelfa. Régime alimentaire de quelques espèces du genre Euryparyphes. Thèse de Magistère en Sciences agronomique, ENSA El-Harrach, Alger.

[9] Biondi, M. & Massa, B. (1995) Le specie nordafricane e italiane del genere Acinipe (Orthoptera Pamphagidae). Fragmenta Entomologica, 27(1), 61–115.

[10] Brisout de Barneville. (1850) Annales de la Société Entomologique de France, 2(8), LXIII (not 63).

[11] Chopard, L. (1943) Orthoptéroïdes de l'Afrique du Nord. Librairie Larose Ed, Paris.

[12] Descamps, M. & Mounassif, M. (1972) Le complexe Orchamus, Paracinipe, Acinipe et Pamphagus (Acridomorpha Pamphagidae). Acrida, 1, 247–303.

[13] Eades, D.C., Otte, D., Cigliano, M.M. & Braun, H. (2011) Orthoptera Species File Online. Version 2.0/4.0. Available from http://Orthoptera.SpeciesFile.org/ April, 2011.

Towards Libyan Research and Education Network (LibREN)

Abubkr A. Abdelsadiq[1] , Ahmed Al-Kilany[2]
[1] *Elmergib University, Ministry of Higher Education, Al Khoms, Libya, abubkr.abdelsadiq@elmerrgib.edu.ly*
[2] *Sebha University, Ministry of Higher Education, Sebha, Libya, Ahm.alkilany@gmail.com*

Abstract: The LibREN (Libyan research and education network) network aims to enhance higher education and research activities in Libya. Through which Universities and research institutions would exchange information, collaborate economically, and approach a world leading research. This paper discusses general issues of LibREN; it introduces the connectivity model and the funding model of the prospective network. We also discuss how the proposed framework would establish collaborative educational virtual environment.

Keywords: Research, Education, Networks, NRENs

1. Introduction

National Research and Education Network (NREN) is a high performance national network connecting educational and research institutions. It is increasingly seen as a vigorous component of modern education. Many countries have adopted NRENs as the cornerstone of their information and communication technology plan for education institutions and other research institutions.

The general NREN networks provide suitable solution with common characteristics; namely, that they are not-for-profit organizations providing advanced services to research and education community. The NREN has become a vital facility that should connect the different academic, research institutions with each other, and facilitate their interaction with the global networks. We note that the term LibREN will be used to refer to the organization that manages the physical network that would be used by the research and educational institutions participated in the LibREN.

Libya is a big country, with a number of higher technical and vocational institutes currently stands at 84 (including 13 public universities) scattered in vast distances. In such a geographical aspect, it is evident that the ways of cooperation among these institutions is limited, especially in the absence of the infrastructure that facilitate travelling and movement from place to another. The design and implementation of LibREN should consider the application of Information Computer Technology (ICT) in education, promoting competitiveness among educational institutions and provide the following services:

- Provision of a dedicated high-speed physical network
- Provide Internet access to LibREN participated institutions
- Provide network services and applications
- Support teaching and learning to LibREN members
- Support\Undertake advanced research
- Encourage relationships with other sectors
- Offer advisory\counselling services

LibREN will be formed to serve universities and main research institutions in the country that are coming together to collaborate and share academic and research knowledge and resources. A future scale should also consider other higher institutions, public libraries and even primary and high schools. A valuable tool for success in this direction is the existence of the most advanced network infrastructure as a support for research and education. Major sections of this paper explore the country' resources (connectivity, fund, expertise, ….etc) and readiness to implement the LibREN.

2. Considerations for Creating the LibREN

This section presents some of the major issues and challenges that LibREN is likely to consider during its development. It is an attempt to capture lessons learned from other countries to decide on some considerations to inform LibREN development and operation in the Libyan state.

A. The physical network model of LibREN

The physical telecommunications network of LibREN is the actual network that will connect education and research institutions directly to each other, to other NRENs and to the commercial Internet. The adopted model for this

discussion is a layered network model discussed in [3] that consists of three dimensions: *layer*, *reach* and type of customer. As shown in Figure (1), the *Layer* dimension composed of *Physical infrastructure*, *Transmission* and *Services*. The physical infrastructure could be cooper wire, wireless (satellite / VSAT, Fixed wireless access, Mobile), Fiber optic and Coax cable, for the transmission Switches, Hubs, Routers, Amplifiers and regenerators are used. The services are voice, video, data, images, the *Applications* are email, web browsing, file transfer, video conferencing and content hosting [4]. The separation between the components of *layer dimension* would help participated institutions work together, discuss shared goals and share assets (bandwidth, fiber optic, VSATs, expertise, research, fund etc..) with each other.

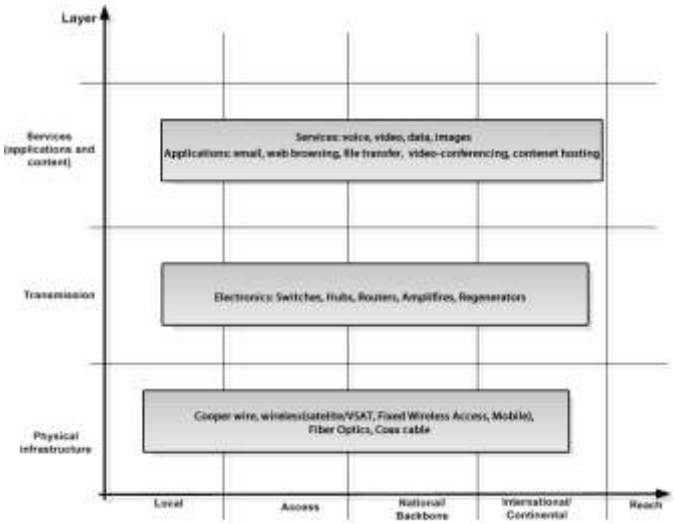


Figure1 *- The network model [4]*

In Libya most of the Universities are not located in one campus. One University may exist in 3 or 4 different cities. This would create scattered little fiber islands that use VSAT or high-capacity fiber lines (if existed) to link fiber islands with each other and make the institution connected. Clearly this would result in a higher cost because of using an international bandwidth for a local traffic. In order to get cheaper connectivity services, one solution to get around this is to persuade other research and educational institutions to be members of the LibREN, that would scale it up and build alliances that lobby national and international telecom companies to offer cheaper prices with proper discounts.

B. The LibREN geographical domains

There are four main geographical domains of interest to the LibREN: Local, access, national and international domains. The networks at all of the various levels are usually interconnected through points of presence (POPs). Below are more details on the various levels of the LibREN network:

- The *local* area network (LAN) is the internal institutional network (or Campus Network). It is usually owned by the education\research institute. It is the foundation for all Research and Education activities, thus the best practices for implementing them should be carefully considered by the LibREN. Without a good campus network, the LibREN can't provide its services as well as it should.
- The *national* network (national backbone) is a high-speed network connecting major towns and cities in the country. It is usually owned by LPTIC Holding (Libyan Post, Telecommunications and Information Technology Company.
- The *international* network connects the LibREN national networks to each other or to international networks. Similar to the national networks, it is usually owned and operated by LPTIC and facilitates the connection to the global NRENs.

In Libya, the *access* (the portion between the institute and a high speed network) network is usually does not exist, of low capacity or unreliable. The weaknesses of the access networks introduce VSAT networks as an alternative solution for LibREN. However, VSATs bypass the local infrastructure by connecting directly to international networks. The implication of this poor infrastructure affects the operational cost of the LibREN and should be studied beforehand.

C. Connecting LibREN to other NRENs

Connecting to other NRENs, as shown in Figure2, goes through number of levels. It starts with the local networks, access network, then national network and finally the regional/international network. The local network is always provided by the institution. The access network usually provided by NRENS via POPs on the nationwide networks to serve hundreds or thousands of institutions [4]. However, for small number of research and education institutions, as in the Libyan case, the LibREN will have to consider provisioning the access network in a direct way to their core networks. The core networks (on the national level) could be fiber, copper cables or via radio networks. Although most of the NRENs in the developed countries are using fiber networks only [2].

Libya is one of the MENA countries with well-developed national terrestrial fiber-optic infrastructure [1], which makes the connectivity through fiber is a handy solution for LibREN. Clearly, this would have a great impact on the development of the LibREN physical network and facilitate the connection to other NRENs. The state-owned companies (LPTIC [6], Hatif [7]) as well as energy grid, oil, and water companies were deploying fiber network infrastructure that can be leveraged for a national\regional broadband network and exploited by LibREN and other NRENs in the region.

We recall that the cornerstone of a successful networking model of LibREN or NRENs in general is the Local Area Network (LAN), which is the network serving a university, school, museum, or research institution and the network closest to the end-user. In some instances, these LANs might connect to another Wide Area Network (WAN) and then to an NREN. In other instances, the LAN may connect directly to the NREN. Similarly, NRENs may connect to a multi-national regional network or directly to other international NRENs. Much will depend upon local conditions, regulatory structures, and geography [5]. In its ideal state, networking is a function of the best technological practices and geography, not politics [5].

Clearly lack of connectivity within the research and education institutions on the local area network level is a major problem. LibREN must carefully focus on promoting building the local area networks within the higher education institutions and ensure that they are following the best practices and recommendations.

The advantage of poor infrastructure on the local level is that LibREN can leapfrog its counterpart NRENs elsewhere in the world and build networks without some of the inherent historical limitations of comparable networks, emphasizing collaboration and mass access to education and research applications across educational sectors. In addition, LibREN should promote for the best guidelines for the prospective network members and ask to combine the best of wireless and mobile technologies with optical networks. Setting up ambitious goals and carefully crafted plans will guarantee LibREN will succeed and provide high class services on the national, regional and international levels.

Figure 2 *- Levels of LibREN networking model*

3. Regulatory and infrastructure aspects

This section discusses some of the organizational and regulatory aspects concerns the LibREN. It is also highlights on the existing fiber infrastructure and that is available for the LibREN.

A. ICT Market structure

Libyan government dominates the entire ICT market. The LPTIC holding Company is the active player in the ICT sector in the country. There are about 8 subsidiaries of LPTIC, 6 of which provide ICT services. The other two companies provide services related to infrastructure, namely:

- International Telecom Company LITC (http://www.litc.ly), which is the owner of the submarine cables and manages international access.
- Albunya Investment and Services Company that offers solutions in infrastructure and maintenance.

Generally the Libyan ICT market organized in a way that separates the types of offered services (see Figure 3 - from the World Bank report, 2014 [1]):

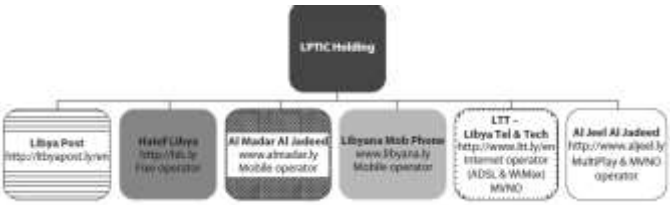


Figure 3 *- Libyan market structure [1]*

LPTIC Holding Company: LPTIC manages subsidiaries and not offer direct services to the beneficiaries of the services. The main role of LPTIC is to develop strategies and implementation plans.
Fixed Operator Hatif Libya: Hatef Libya (http: // hlc.ly), the state-owned company is responsible for the operating the fixed wire and wireless telephone services and the related civil works.

Libyana: is a state-owned company that sets prices and provide its services to the customers. The company is modernizing the 3G network and deploying 4G of mobile telecommunications technology.
El Madar Al Jadid: offer GPRS services providing low speed data connectivity services allowing end users to access e-mails and/or read news.

Aljeel Aljadeed: Primarily created to contribute to the improvement and development of Libya's telecommunications sector, it is using the existing infrastructure managed by LPTIC and Hatef Libya.
Libya Telecom and Technology: LTT provides four different internet access offers: Dial up access; Libya ADSL, Libyamax (based on WiMax), and Satellite DVB-RCS Access. In 2013, the government authorized another 19 private ISPs to offer ADSL services.

B. International\ National connectivity status

The international connectivity of Libya is secure and has sufficient capacity to meet current and future medium-term needs [1]. With a combined capacity exceeding 4 Tbps, three submarine cables, plus two terrestrial cross-border connections.

In terms of national connectivity, Libya categorized as one of the well-developed national terrestrial fiber-optic infrastructure. Many companies have contributed to wide-spread of fiber infrastructure in the country, brief details on the following bullets as they appeared in the *world bank report on Broad Band Networks in North Africa and the Middle East report, January 2014*:

- LPTIC Infrastructure:
  LPTIC covering the main cities of Libya, it can be split into two different parts:
  - Legacy Infrastructure (Hatif) interconnects 107
  cities mainly along the Mediterranean coast.
  - NGBN Infrastructure the Next Generation
  Backbone Network (NGBN). Planned to install
  24,000 km of new fiber-optic infrastructure across

- GECOL Energy Grid:
  General Electricity Company of Libya has a large fiber-optic infrastructure along its THT/HT power lines.

- Libyan Oil and Gas Companies:
  Various Libyan oil and gas companies have laid fiber-optic cable along their pipelines.

- Man-Made River Project:

The Man-Made River (MMR) Project is a network of pipes that has been equipped with fiber-optic cable.

4. The LibREN funding model lib

This section presents different ways that can be adopted for acquiring and deploying NRENs. Then it discusses the funding model for the LibREN in particular. For long-term operational network, it is crucial to identify the resources of fund for LibREN in an early stage of the project development.

A. Different ways of NRENs deployment

As in the European countries, there are four main ways (or models) by which NRENs can go about acquiring and deploying their networks [4][9]. Following is a quick review of the common models of NRENs deployment. We also examine what is the most applicable model for the case of LibREN:

- Model 1 - NREN can build its own networks. This would involve laying own fiber and provisioning necessary transmission equipments or by deploying wireless systems such as microwave links.
- Model 2 - Lease of infrastructure, so NRENs can lease existing but unused infrastructure e.g. dark fiber from telecommunications providers or other entities such as electricity and rail companies.
- Model 3 - NRENs would lease dark fiber or dedicated wave lengths on fiber or dedicated channels on microwave link with the telecommunications providers owning all transmission equipments.
- Model 4 - NRENs would purchase capacity or bandwidth from service providers between two or more points.

	Initial cost	Recurrent capacity cost	existing providers' capacity required	Existing provider's network coverage required	Technical expertise required
Model1	Very high	Nil*	Nil+	High	Very high
Model2	High	Nil*	Nil +	High	High
Model3	Medium	High	High	High	Medium
Model4	Low	High	High	High	Medium

*With Model1 and 2 NREN stil incur costs for maintaining and servicing their own connections and transmission equipment but do not incur monthly bandwidth charge

+Model 1 and 2 do not require that existing service providers have high capacity networks as they do not rely on existing capacity.

***Table 1**- An approach to select NREN'S ownership model [4]*

Table 1 - (see [4] for more details) - shows an approach to select the appropriate NREN model for deploying the NREN networks. The development and operational costs would vary depending on the model of choice. Applying this approach on LibREN requires careful analysis of access and national networks in terms of performance, reliability and connectivity gaps. In fact careful analysis of the current connectivity status of the local and national levels would help LibREN to decide on the right model of deployment in a proper way. This should ideally be one of the key first steps in LibREN development.

There are no studies have been attempted (or published) on the best model that can be used to deploy NRENs in Libya. However, based on the review of the infrastructure aspects in *Section III* of this paper, Model 2 is very appealing. As *Tabel 1* shows, the model requires high initial cost, high network coverage and high technical expertise. If a coalition of education and research institutions have been formed, the problem of initial cost will be defeated, as well as, the necessity of high technical expertise. For the later one, the research and education institutes would find their way to train and educate the appropriate staff take care of technical issues of the network.

B. LibREN funding model

The majority of successful NRENs (in Europe and the other world) receive funding support from national government. Similarly on the international level GÉANT[8] network, that connects European NRENs internationally, has been receiving a financial contribution from the European Commission. Therefore, receiving funding support from the government is the key for success for LibREN and NRENs in general. However, for more financial independence and to avoid bureaucracy in the country's administration system users should be prepared to make a financial contribution for the production services they use. The user’s contribution would help LibREN to overcome the daily operating costs. As a result there would be a hybrid funding model, where users pay a fair

contribution to the cost of production services, whilst government takes the longer-term view funding innovation and upgrades.

5. Conclusions

In this paper we were trying to be the initiatives of this national project and shed-the-light on the general aspects of the Libyan Research and Education Network (LibREN) network. We found a wealthy resource (Fiber optic infrastructure) that is not exploited properly for the benefit of academics, industry and for the benefit of citizens general. We discussed the connectivity as well as the funding models that would make the LibREN success.

We conclude that the LibREN will be a major asset for the Libyan economic growth and prosperity. It would serve the education and research community and promote academic collaboration on the national and international levels. It will be a source of much Internet innovation that would benefit the whole society and expand to the commercial Internet as well. The government should regard the LibREN as a national request and sponsor it by all means.

6. References

[1] Natalija Gelvanovska, Michel Rogy, C. M. R. (n.d.). *Broadband Networks in the Middle East and North Africa*. Washington DC 20433: The World Bank.

[2] Falch, M., Saugstrup, D., Skouby, K. E., & Davies, D. (n.d.). Report discussing future scenarios for the funding of network infrastructure in the European research networking community , and of related costs, (December 2003).

[3] Spintrack AB. 2005. Open Access Models: Options for Improving Backbone Access in Developing Countries. Washington, DC: infoDev / World Bank. Available at: http://www.infodev.org/en/Publication.10.html

[4] Twinomugisha, A.. NATIONAL RESEARCH AND EDUCATION NETWORKS IN AFRICA, (January), 1–54, (2007).

[5] Louis Fox. African NRENs can expand educational opportunities across education sectors, http://edutechdebate.org, June 2011.

[6] LPTIC Holding (Libyan Post, Telecommunications and Information Technology Company [http://www.lptic.ly])

[7] Hatif Libya (http://hlc.ly)

[8] The pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs) (http://www.geant.net)

[9] SERENATE report Deliverable D14 Report, Discussion on the network infrastructure in the European research networking community (http://www.serenate.org/publications/)

eage2014.asrenorg.net

www.asrenorg.net