Impact case study (REF3b)

Institution: University of South Wales

Unit of Assessment: B11

Title of case study: Mobile applications and technologies making economic impact

1. Summary of the impact

Mobile technologies and in particular mobile applications have become key drivers of the economy in many countries especially those that lack established communications infrastructures. Since 2003, the research team led by Professor Al-Begain has created both significant infrastructure and know-how that became the base for the creation of the £6.4million Centre of Excellence in Mobile Applications and Services (CEMAS) that is providing research and development to SMEs in Wales to increase their competitiveness. In the first three years since its inception 28 projects have been completed and 66 companies have received services.

2. Underpinning research

The team led by Professor Al-Begain has been conducting fundamental and experimental research in a number of key areas. Underlying fundamental research focuses on developing mathematical models to assess the performance and the survivability of systems. The methodologies used include numerical and queuing models as well as simulation. We developed a simulation system with a multi air interface wireless network to study the effect of mobility on horizontal and vertical handover as well as the evaluation of different packet scheduling schemes in HSDPA and LTE wireless networks [1]. General queuing models were developed for assessing the survivability of systems that are capable of capturing significant system behaviour and are capable of providing insight into system capability to continue to provide acceptable level of service in case of disasters [2]. In this work, we introduced a new concept in the form of "propagated failures". This work was partly supported by a Royal Academy of Engineering grant.

One key area of our experimental research has mainly focused on developing a world-class industry grade Next Generation Network (NGN) facility that comprises a fully functional IP Multimedia Subsystem (IMS) to allow the development of a range of techniques for innovative applications and services [4][6]. The £1million NGN-IMS facility was a result of joint research projects supported by Orange Labs and Ubiquity technologies [4]. This formed the foundation for the establishment of CEMAS to utilise the outcomes of the research in this facility to support businesses in Wales through an innovative business support programme (Impact Claim 1). This setup has also become the core for the Mission Critical Voice over 4G mobile networks (MC VoLTE) which utilises the NGN-IMS setup and includes key components such as a SIP Server, Media Gateway and Push-to-talk Servers (Impact Claim 3).

Another key area of research is concerned with developing new session mobility algorithms and video transcoding methods [5] that allow video streaming over and across different network domains without call interruption. As a result, the research projects on video to mobile techniques (2008-2009) [5] resulted in a patented security system licensed to a University spin-out company (Glamex Security Ltd) (Impact Claim 2). Furthermore, Prof. Al-Begain and Dr. Alhad Kuwadekar developed a session mobility algorithm that became the base for the "MediaShare" IPTV complete multiplatform system.

In our research on sensor technologies, we created context aware mobile applications in a number of areas including early recovery in large scale disaster scenarios, assisted living and diagnosis of early dementia, and energy monitoring in home environment. (Impact Claim 1).

In the case of disaster recovery and resilience, the group developed a Hybrid Network Emergency Communication protocol [3] with all underlying algorithms that can be rapidly deployed in areas of large scale disasters. The work is based on collaboration with University of Castilla-La Mancha, Spain, and resulted in developing a common middleware and system that allows unified

communication and data collection over both MANET and sensor networks. The research on survivability of communications systems in disaster scenarios complemented the theoretical, analytical and numerical models mentioned above [2].

A second application area of our research on sensors is for energy monitoring. This research has provided the technological base for the EU FP7 €5million ICE-WISH project aiming at monitoring and reducing energy consumption in social housing by 13% implemented in 10 EU countries (http://www.ice-wish.eu/uk/icewish.asp).

Still within the area of sensor technology, the team has also developed a system that allows the establishment of behavioural patterns for the detection of early stage symptom of dementia and developed a system for monitoring the care process provided to elderly patients.

Research Team
Professor Khalid Al-Begain (2003 –), Dr. Chitra Balakrishna (2009-2013), Dr. Alhad Kuwadekar (2010 -) (both Balakrishna and Kuwadekar were awarded PhDs during the period), Mr. Nidal Albeiruti (Senior Developer 2011-), Mr. Charles Turyagyenda (Research Fellow 2012-) and Professor Alexander Dudin (visit for 1 month in 2010).

3. References to the research

bolded references selected as best indicating the quality of the underpinning research

[1] S. Y. Yerima and K. Al-Begain: "Novel Radio Link Buffer Management Schemes For End-User Multi-Class Traffic In High Speed Packet Access Networks", Wireless Personal Communications, May 2010. DOI: 10.1007/s11277-010-0027-3   (REF output)

[2] K. Al-Begain, A. Dudin, V.Klimenok, S. Dudin: Generalized survivability analysis of systems with propagated failures, Computers & Mathematics with Applications, March 2012, ISSN 0898-1221, DOI: 10.1016/j.camwa.2012.02.053F   (REF output)

[3] A. Baryun, K. Al-Begain, D, Villa: HNEC: A Hybrid Network Emergency Communication Model, International Journal of Handheld Computing Research (IJHCR) 4(2), 17-39, 2013 (REF output)

[4] C. Balakrishna and K. Al-Begain: "Towards a User-Centric and Quality-Aware Multimedia Service Delivery Implementation on IP Multimedia Subsystem" in Proceedings of the 2007 International Conference on Next Generation Mobile Applications, Services and Technologies, NGMAST '07, IEEE Conference Publications, Page(s): 36 - 42. DOI: 10.1109/NGMAST.2007.4343398.

[5] A. Kuwadekar, A. Joshi and K. Al-Begain: Real Time Video Adaptation in Next Generation Networks, in: Computational Intelligence and Communication Networks (CICN), Nov. 2010, pp 55 - 61   (REF output)

[6] K. Al-Begain, C. Balakrishna, L. Galindo, D. Moro: IMS, Development and deployment perspective. John Wiley and Sons, New York, 2009.

Grants:

➕ *K. Al-Begain: Centre of Excellence for Mobile Applications and Services (CEMAS), ERDF Convergence Fund (£4.96millions). 1 September 2010 – 31 December 2015. (Principal Investigator and Director)*

➕ *K. Al-Begain: Additional funding for CEMAS, ERDF Convergence Fund (£1million). 1 June 2013-December 2015. (Principal Investigator)*

➕ *K. Al-Begain: ICE-WISH: "Demonstrating through Intelligent Control (smart metering, wireless technology, cloud computing, and user-oriented display information), Energy and Water wastage reductions In European Social Housing"; FP7 ICT PSP Project with 18 partners from 11 countries. (Project Budget 4.92 million Euros; UoG share 243K Euros) (UoG Principal Investigator) April 2011.*

➕ *K. Al-Begain: ICE-WISH (Additional €55k allocated to UoG in Feb 2013).(UoG PI)*

➕ *K. Al-Begain: "Care for Business": Collaborative WAG A4B Project with Swansea Uni, Glyndwr Uni, and Bangor Uni. (Total £143K; UoG £6K) (Co-Investigator)*

> ♣ *K. Al-Begain: EU-COST-290 Action on "Traffic and QoS Management of Wireless Multimedia Networks. (Member)*
> ♣ *K. Al-Begain: Royal Academy of Engineering Distinguished Visiting Professorships Fellowships in Communications (£6,000) (2009) (Principal Investigator)*

4. Details of the impact

IMPACT CLAIM 1: Our research on next generation mobile applications and services led to the creation of a unique business assistance programme for SMEs in Wales.
The research on next generation networks, services and applications laid the foundation for the business case for the £5million Centre of Excellence in Mobile Applications and Services approved in September 2010 that aims at providing research and application development to SMEs in Wales (2010-2015). The Centre is funded by the Welsh European Funding Office using the European Regional Development Fund to give companies in Wales a competitive advantage in the areas of the research of the centre through its 18 staff. By July 2013, the Centre has provided assistance in forms of research and development services to 66 companies, developed 28 products (4 in IP protection process with CEMAS support). The Centre is having real impact including the formation of 6 new companies, creating 8 jobs and further opportunities in the area. Many of these projects were based on current research results in the group on sensor networks and VoIP and their integration into apps.

A product developed by CEMAS ("HorseRation") for Arkirus Ltd received a British Equine Trade Association Award for Innovation in February 2013.

Acknowledging the impact of CEMAS, the funders approved a further £500K funding in July 2013 increasing thus the size of the project to £6.4million.

IMPACT CLAIM 2: Research on video streaming and transcoding led to formation of a new spin off company:
Part of the research on video to the mobile using SIP and 3G technologies has been filed as a patent (UK Patent Application No 1009435.7) and a company called Glamex Security Ltd with external investment over £220k was formed in 2009. It has developed the system called "LiveGuard". The "LiveGuard" product is innovative, as it comprises the results of the research published in [2][3] and [5] and other publications by the group regarding video streaming over multiple networks including transcoding and is implemented on Android to be embedded in consumer devices such as Smart TVs. The company has won two major contracts for sites in Wales (Japanese Car parts Manufacturer, Jtekt) and South Africa (KLT Car parts Factory) in addition to 5 smaller installations in 2012 with overwhelming positive feedback. In May 2013, Glamex secured a further £400k investments and is creating distribution channels in 5 international regions. Additionally an agreement for partnership is being finalised with the National Federation of Retail Newsagents (NFRN) which represents over 16500 news and convenience retailers across the UK and Ireland.

The product developed by the team was a finalist for the "Best CCTV System of the Year" at the IFSEC International Security Exhibition in Birmingham in May 2012. It was also featured as the "Security Solutions Company of the Month" by the "Building and Facilities News" a widely distributed industry magazine in July 2012 (Issue 886).

IMPACT CLAIM 3: our research on next generation networks and IMS, in particular, as well as on disaster scenarios is contributing to the creation of world first Mission Critical Voice over LTE (MC VoLTE) over 4G networks.
General Dynamics has commissioned collaborative research (through its EDGE programme) and consultancy services from Professor Al-Begain and his team to support developing and optimising the world first MC VoLTE based on Push-to-Talk technology with high level quality constraints. The system will be based on components developed by the team such as the GenXfone IMS client and the SIP-based Push 2 talk Server.

IMPACT CLAIM 4: Research on sensor applications and NFC led to the development of MOCAD (Mobile Carer Assistant System).

The research team has developed a novel cost effective system that uses non-intrusive technology to monitor the normal daily behaviour of elderly people to establish normal behavioural patterns. This allows the detection for any change in behaviour that might be a symptom of dementia or other aging related diseases.

In the same context, the team developed an innovative methodology and a tool (MOCAD) for monitoring carers' attendance including scheduling, recording visits and providing assistance to carers to provide more efficient service to patients using the combination of GPS (Global Positioning System) and NFC (Near Field Communications) technologies in an innovative way. Care System Integration Ltd is utilising these services in systems for councils in England and Wales with a pilot of 45 units in the Rhonda Cynon Taff in Wales. Larger scale deployment is planned in Liverpool as part of a £2million TSB funded project (Caring Cloud) that includes also the mobile operator O2 and others.

IMPACT CLAIM 5: The research on the Hybrid communications system that comprises both Mobile Ad hoc networks and sensor networks is influencing the standardisation efforts in the final EC COST290 report and the Autonomous network theme and in particular their usage for emergency systems.

Our research outputs have influenced the COST 290 project and have also been included in the Final report of the COST 290 project. Professor Al-Begain co-authored Chapter 4 of the final report on Mobility and contributed to editing the final report.

5. Sources to corroborate the impact

CLAIM 1:
-   Official Report and Claim to Welsh European Funding Office, Welsh Government
-   Names and addresses of the companies assisted by CEMAS and the list of Products developed. A complete list of projects is available on http://www.cemas.mobi/
-   List of events (Mobile Apps Showcase event and others) also on http://www.cemas.mobi/
-   Welsh European Funding Office news release http://wefo.wales.gov.uk/news/latest/7313240/?skip=1&lang=en

CLAIM 2:
-   Glamex Security Ltd Website http://www.glamex.co.uk/
-   UK Patent Pending (Published) GB1009435.7 "Security System".
-   IFSEC 2012 Awards Website http://www.ifsec.co.uk/Content/2012-Finalists/9_149/.
-   Building and Facilities News issue 886 http://www.buildingandfacilitiesnews.co.uk/issues/886.pdf

CLAIM 3:
-   Commercial contract between General Dynamics and University of Glamorgan Commercial services, May 2013.

CLAIM 4:
-   Care Systems Integration Ltd http://www.csintegration.co.uk/
-   Letter from CEO of Care System Integration Ltd

CLAIM 5:
-   Barcelo-Arroyo, Torres, Al-Begain, Martin-Escalona, and Vassiliou: "Chapter 4: Mobility" In Koucheryavy, Siris, Braun, Barcelo-Arroyo, Giambene, Staehle (eds.) Traffic and QoS Management in Wireless Multimedia Networks"; COST 290 Final Report, Lecture Notes in Electrical Engineering 31 (2009) Springer Verlag. DOI 10.1007/978-0-387-85573-8