<table>
<thead>
<tr>
<th>Project and Deliverable Information Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project GA</td>
</tr>
<tr>
<td>Project acronym</td>
</tr>
<tr>
<td>Project website</td>
</tr>
<tr>
<td>EC Project Officer</td>
</tr>
<tr>
<td>Deliverable ID</td>
</tr>
<tr>
<td>Deliverable Title</td>
</tr>
<tr>
<td>Deliverable version</td>
</tr>
<tr>
<td>Deliverable key words</td>
</tr>
<tr>
<td>Deliverable nature</td>
</tr>
<tr>
<td>Dissemination level</td>
</tr>
<tr>
<td>Contractual Date of Delivery</td>
</tr>
<tr>
<td>Actual Date of Delivery</td>
</tr>
<tr>
<td>File name</td>
</tr>
<tr>
<td>Author</td>
</tr>
<tr>
<td>Contributors</td>
</tr>
<tr>
<td>Review team</td>
</tr>
<tr>
<td>Approved by Coordinator</td>
</tr>
</tbody>
</table>
### Quality Control Assessment - Document Status Sheet

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Comment</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>V0.1</td>
<td>24/11/13</td>
<td>First draft</td>
<td>Björn Pehrson (KTH)</td>
</tr>
<tr>
<td>V0.2</td>
<td>25/11/13</td>
<td>Peer review</td>
<td>Hannes Toivanen (VTT)</td>
</tr>
<tr>
<td>V0.3</td>
<td>25/11/13</td>
<td>Second draft</td>
<td>Björn Pehrson (KTH)</td>
</tr>
<tr>
<td>V0.4</td>
<td>29/11/13</td>
<td>Third draft</td>
<td>Karl Jonas (Fraunhofer)</td>
</tr>
<tr>
<td>V0.5</td>
<td>19/12/13</td>
<td>Peer review</td>
<td>Barend Taute (CSIR/Meraka)</td>
</tr>
<tr>
<td>V0.6</td>
<td>07/01/13</td>
<td>Quality check</td>
<td>Laura De Nale (Sigma Orionis)</td>
</tr>
<tr>
<td>V0.7</td>
<td>08/01/13</td>
<td>Final version</td>
<td>Karine Valin (Sigma Orionis)</td>
</tr>
<tr>
<td>V1.0</td>
<td>08/01/13</td>
<td>Submission to the EC</td>
<td>Karine Valin (Sigma Orionis)</td>
</tr>
</tbody>
</table>

**Disclaimer**

All intellectual property rights are owned by the EuroAfrica-P8 consortium members and are protected by the applicable laws. Except where otherwise specified, all document contents are: "© EuroAfrica-P8 project - All rights reserved". Reproduction is not authorised without prior written agreement.

All EuroAfrica-P8 consortium members have agreed to full publication of this document. The commercial use of any information contained in this document may require a license from the owner of that information.

All EuroAfrica-P8 consortium members are also committed to publish accurate and up to date information and take the greatest care to do so. However, the EuroAfrica-P8 consortium members cannot accept liability for any inaccuracies or omissions nor do they accept liability for any direct, indirect, special, consequential or other losses or damages of any kind arising out of the use of this information.
Project Abstract

Africa and Europe have recognised that Science, Technology and Innovation (STI) and the spreading of Information and Communication Technologies (ICT) to all sectors of society are key to their development. ICT is an as important infrastructure as roads, power, water and sanitation, etc. The ‘8th Africa-EU Strategic Partnership’ (‘Partnership 8’ or ‘P8’) interlinks three priorities, which can leverage a faster socio-economic development in Africa: Science, Technology and Space. The Partnership 8 Action Plan II lists an inclusive information society in Africa as a priority for the development cooperation. From this perspective, a multi-stakeholder implementation group was formed, co-chaired by the African Union Commission (AUC) and the European Commission (EC) and aimed at enhancing cooperation between the two regions.

EuroAfrica-P8 is an FP7 project funded by the European Commission (DG CONNECT) and spanning 24 months (2012-2013) with the aim of strengthening ICT research and policy links between Africa and Europe under the ‘8th Strategic Partnership’. The project is defined in full continuity with and builds upon the substantial results obtained and the significant momentum created by several previous projects (2006+), designated - over the years - as ‘the EuroAfrica-ICT Initiative’.

The project is gathering partners able to significantly impact the expansion of Euro-African cooperation on ICT research in close liaison with the EC and the AUC and in partnership with key stakeholders in the field.

The Consortium consists of eleven partners with significant experience in ICT policies in both regions, as well as in Africa-EU S&T/ICT cooperation. They enjoy access to important networks and they have previously participated in EU/FP projects. Collectively they complement each other in such a manner that the consortium is well balanced and qualified to reach the project objectives.

**EuroAfrica-P8 main objectives**

- Strengthen EU-African policy and ICT research links with the aim of reinforcing the ‘8th Africa-EU Strategic Partnership’ (P8);
- Identify, analyse and map EU-African joint ICT research priorities;
- Provide evidence-based recommendations to the European and African Union Commissions for future cooperation initiatives;
- Provide support and guidance to European and African organisations in their efforts to connect and develop joint research projects in the ICT field;
- Support and sustain the activities of the P8 Africa-EU Implementation Group on ICT and the Joint Expert Group (JEG8);
- Enhance the participation of African organisations in FP7/Horizon2020 collaborative projects; and
- Achieve strategic coordination with other initiatives/projects/programmes sharing similar or related objectives.

**EuroAfrica-P8 main activities**

- Provide support and guidance to European and African organisations in their efforts to connect and develop joint research projects in the ICT field through:
  - An interactive, consistent and dynamic portal website;
o A repository of key information related to EU-African cooperation on ICT research;
  o A virtual community of researchers;
  o An online database of African research institutes addressing ICT;
  o An e-Booklet entitled ‘Spotlight on African ICT research institutes’;
  o Helpdesk services; and
  o Communication material (quarterly e-Newsletters, video trailer, brochures and posters, etc.).

- Organise cooperation/thematic events synchronised, when possible, with policy dialogue meetings:
  o 2 ‘Euro-African FP7/ICT thematic working group meetings’ to be hosted in Europe in 2012 and 2013;

- Identify, analyse and map joint ICT research priorities between the two regions, in support of strengthening Euro-African collaboration (the diagram below indicates the 6 Focus Areas selected by the project Consortium);

**6 FOCUS AREAS FOR JOINT AFRICA-EU ICT RESEARCH RECOMMENDATIONS**

1. **1 - HEALTH**
   - Remote communities, consultation, records, logistics, diagnostics, sentinel surveillance, telemedicine, training, business models, etc.
2. **2 - ENVIRONMENT & ENERGY**
   - Green ICT, earth observation, adaptation to climate change, climate monitoring, disaster alerts, energy efficiency, etc.
3. **3 - LEARNING**
   - E-learning content delivery platforms, inclusion, via mobile, accreditation, models, teacher training, etc.
4. **4 - AGRICULTURE**
   - Irrigation schemes, knowledge access, market intelligence, weather information, planning, sensor networks, etc.
5. **5 - ICT INFRASTRUCTURE**
   - Broadband, mobile, application development, wireless, NRENs, HPC, spectrum use, scalability, regional integration, last mile, business models, etc.
6. **6 - GOVERNMENT SERVICES**
   - Modernisation, e-Government, governance, regulations, information portals, etc.

Cross-cutting areas, technologies and methodologies that support all the thematic areas: trust & security, living labs, innovation incubators, research infrastructure, future internet, language technologies, standards and norms, etc.

- Produce recommendations for future cooperation initiatives;
- Form 5 consortia working on joint EU-Africa EU FP7/Horizon2020 proposals.
demonstrating the return on investments in e-infrastructures and their supply chains;

- Produce 4 to 6 zoom/case studies (success stories, innovative ICT research/technological developments or results in specific African countries or regions);

- Publish 2 iterations of an e-Consultation aimed at achieving strategic coordination with other initiatives or programmes sharing similar or related objectives;

- Assist the day-to-day operation of the ‘Africa-EU Strategic Partnership on Science, Information Society and Space’ (P8) multi-stakeholder implementation group on ICT and the JEG8 - Improving as much as possible the operation of Partnership 8;

- Ensure the participation of key stakeholders in the P8 group meetings.

The EuroAfrica-P8 task reported in this deliverable is task 3.4, the Lighthouse Demonstrators established under the project. These include affordable infrastructure solutions for underserved rural areas and key applications in Governance, Health, Education and Environment. They have been demonstrated during the EU ICT2013 event in Vilnius and during the UbuntunetConnect week in Kigali (both during November 2013) where they were also presented as part of the joint CHAIN-REDS/eI4Africa workshop. They have also been presented and discussed in several other informal contexts.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT ABSTRACT</td>
<td>3</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>8</td>
</tr>
<tr>
<td>1 – APPROACH</td>
<td>10</td>
</tr>
<tr>
<td>1.1 – OVERARCHING PROCESS</td>
<td>10</td>
</tr>
<tr>
<td>1.2 – METHODS AND TOOLS</td>
<td>10</td>
</tr>
<tr>
<td>1.2.1 FIRST MILE INITIATIVES</td>
<td>11</td>
</tr>
<tr>
<td>1.2.2 SYNERGISTIC COOPERATION WITH OTHER ONGOING PROJECTS</td>
<td>11</td>
</tr>
<tr>
<td>1.2.3 TECHNOLOGY TRANSFER ALLIANCE</td>
<td>11</td>
</tr>
<tr>
<td>1.3 – SELECTION CRITERIA</td>
<td>11</td>
</tr>
<tr>
<td>2 – TOPICS</td>
<td>13</td>
</tr>
<tr>
<td>2.1 – GOVERNANCE</td>
<td>13</td>
</tr>
<tr>
<td>2.1.1. REGIONAL COOPERATION HARMONISATION OF POLICIES AND REGULATIONS</td>
<td>14</td>
</tr>
<tr>
<td>2.1.2. ICT FOR RURAL DEVELOPMENT STRATEGIES</td>
<td>15</td>
</tr>
<tr>
<td>2.2 – HEALTH</td>
<td>16</td>
</tr>
<tr>
<td>2.2.1. RATIONAL DRUG MANAGEMENT APPLICATION</td>
<td>16</td>
</tr>
<tr>
<td>2.2.2. SEARCH FOR PHYTO-MEDICINES</td>
<td>17</td>
</tr>
<tr>
<td>2.2.3. INTERNATIONAL MEDICAL EXPERT SEMINARS VIA HDVC</td>
<td>17</td>
</tr>
<tr>
<td>2.2.4. REMOTE CONSULTATIONS IN THE REFERRAL CHAIN</td>
<td>17</td>
</tr>
<tr>
<td>2.2.5. COMMUNITY HEALTH Portal</td>
<td>18</td>
</tr>
<tr>
<td>2.3 – EDUCATION</td>
<td>18</td>
</tr>
<tr>
<td>2.3.1. SCHOOL CONTENT DEVELOPMENT</td>
<td>18</td>
</tr>
<tr>
<td>2.3.2. CONTINUING EDUCATION FOR HEALTH WORKERS</td>
<td>18</td>
</tr>
<tr>
<td>2.4 – ENVIRONMENT</td>
<td>19</td>
</tr>
<tr>
<td>2.4.1. DEVELOPMENT OF AUTOMATION OF OBSERVATION STATIONS AND DENSIFFICATION OF THE OBSERVATION NETWORK</td>
<td>19</td>
</tr>
<tr>
<td>2.4.2. DRINKING WATER QUALITY</td>
<td>20</td>
</tr>
<tr>
<td>2.4.3. DROUGHT MANAGEMENT</td>
<td>20</td>
</tr>
<tr>
<td>2.4.4. EARLY WARNING SYSTEM FOR LAND SLIDES</td>
<td>20</td>
</tr>
<tr>
<td>2.4.5. FARMING MANAGEMENT INFORMATION SYSTEMS</td>
<td>21</td>
</tr>
<tr>
<td>2.5 – ICT AND ASSOCIATED ENERGY INFRASTRUCTURE</td>
<td>21</td>
</tr>
<tr>
<td>2.5.1. AFFORDABLE AND ROBUST GREEN RURAL NETWORKS</td>
<td>21</td>
</tr>
</tbody>
</table>
2.5.2. First Mile Fibre Deployment ................................................................. 21
2.5.3. Wireless Broadband Backbones and Access Networks .................. 22
2.5.4. Energy Planning Tools and Smart Micro-grids ................................. 23
2.6 – Innovation and Entrepreneurship ......................................................... 24

3 – Calls to Target and Proposals Submitted .............................................. 25

3.1 – African Union Calls .............................................................................. 25
3.2 – EU/FP7 Calls ........................................................................................ 25
3.3 – National Calls ....................................................................................... 25
3.4 – Calls from Donors and Financial Institutions ..................................... 26
  3.4.1. NORAD ............................................................................................... 26
  3.4.2. African Development Bank ............................................................... 26
  3.4.3. WB Programmes .............................................................................. 26
  3.4.4. SIDA/SPIDER ............................................................................... 26
3.5 – Other Funding Opportunities ................................................................. 26
  3.5.1. Technology Transfer Alliance ........................................................ 27
  3.5.2. The Somali Diaspora in Sweden ...................................................... 27

Conclusions .................................................................................................. 28

References .................................................................................................... 30
Introduction

The present document is a deliverable of the EuroAfrica-P8 project (Grant Agreement #288309), funded by the European Commission’s Directorate-General for Communication Networks, Content and Technology (DG CONNECT), under its 7th EU Framework Programme for Research and Technological Development (FP7).

The EuroAfrica-P8 project is divided into Work Packages (WP), each of them being sub-divided into Tasks (T). The Task reported here (Task 3.4 - Lighthouse demonstrators) set out to form and activate consortia of mixed African, EU and other stakeholders to deliver five project proposals for implementation of high quality lighthouse/flagship demonstrators illustrating the return on investments in ICT for research and education.

The consortia and projects have been selected, formed and focused in close cooperation with the policy-makers responsible and considering regional, national and local ICT and poverty alleviation strategies and implementation plans.

The method used has been to form public-private partnerships (PPP) according to the methodology laid out in the First Mile Initiative [1] concept proposed to the UN Broadband Commission [2] via its Working Group on Science and Technology [3]. Local communities teaming up with research and higher education institutions play important roles as drivers of the involvement of private sector via social businesses and pre-commercial procurements. The objective has been to stimulate policy and regulatory dialogue leading to local support for development projects by “midwifing” at least five projects involving high quality demonstrators, in different regions in Africa. The resulting projects discussed below mainly involve the Horn of Africa, the East African Community member states and their closest neighbours, and West Africa.

Projects were identified using a bottom-up approach within the “6 Focus Areas for Joint Africa-EU Research” identified by the EuroAfrica-P8 project consortium, indicated in the Project Abstract above. A starting point has been cross-cutting issues in the health, education and local administration sectors, including environment monitoring and support to local entrepreneurs, often farmers. Examples of development projects discussed include ICT infrastructure in general, information systems for secure distribution and monitoring of the use of drugs, telemedicine consultations between healthcare units in the referral chain, strengthening of local support for e-Learning, local planning and budgeting of ICT for healthcare and education, environment monitoring and development strategies for the establishment of sustainable ICT markets where there is demand but no commercial supply.

Besides inputs from and interaction with the EuroAfrica-ICT, EuroAfrica-P8, CHAIN-REDS and e14Africa project activities, the task also took inputs from the FEAST and ERINA4Africa studies and exploited synergies with other ongoing projects, including a large number of active EU/FP7 projects such as AfricaConnect on the infrastructure side and many application oriented projects addressing the topics discussed below, as well as bilateral programmes supported by SIDA, NORAD, NUFFIC, DFID, IDRC, USAID, etc.

Besides the ongoing demonstrator projects, another output from this task is improved relations between all stakeholders resulting from discussions about policy issues and development strategies, from the UN Broadband Commission to regional and national policy-makers and the private sector. The development of academic cooperation between leading universities in Europe and Africa via the Technology Transfer Alliance is another example of this output.
When selecting demonstrator projects, priority has been given to capable coordinators and consortia, close cooperation with policy makers, regulators and private sector addressing cross-cutting issues in Public Private Partnerships.

A special focus has been put on rural areas according to the First Mile Initiative methodology, exploiting and benefiting from synergies with other initiatives as well as including policy issues and development strategies leading to improved relations between the EU and Africa.

The present deliverable (D3.4.2 – Lighthouse demonstrators), prepared by KTH (Project Task Leader), is the final report related to this task. Since the EuroAfrica-P8 project is coming to an end, some of the results will be further developed by other projects funded by the EC (e.g. eI4Africa) and projects funded via other sources than EC.
1 – Approach

The approach taken to meet the objectives of the task described above includes an overarching process, methods and tools, criteria for selection of demonstrator development projects and criteria for dropping them in case of insufficient progress.

1.1 – Overarching process

The overarching process includes the following steps:

- Step #1: The list of ideas for demonstrator projects and interested coordinators, potential consortia of stakeholders and calls from potential funders to target have been discussed continuously in the EuroAfrica-P8 consortium, with other parallel projects and occasionally, when an opportunity has been offered, also with EC-representatives and regional and national policy-makers to make sure that their priorities are met by the selected set of demonstrators. This has happened at the IST-Africa events in Dar es Salaam (May 2012) and Nairobi (May 2013), the EuroAfrica-ICT FP7 Awareness Workshop in Maseru, Lesotho (June 2012) and at the ‘2012 Africa-EU Cooperation Forum on ICT’ in Lisbon (Nov. 2012).

- Step #2: As a second step, we have been working closely with the selected coordinators to organise their project planning and proposal process, including work procedures and searching for seed funding to cover costs for the planning process. We will discuss below which funding opportunities we have been trying to take advantage of, sometimes successfully, sometimes not.

- Step #3: The Task Leader has been coaching the identified and selected coordinators and other consortium members by providing them feedback on progress reports and making sure that deadlines will be met and deliverables delivered. In some cases KTH and other consortium members have become partners in submitted proposals.

- Step #4: Finally the Task leader and partners have contributed to a wide dissemination of information in terms of progress reports and results (through WP2 - Project Dissemination) to the whole EuroAfrica-ICT community. This has happened at the IST-Africa events in Dar es Salaam (May 2012) and Nairobi (May 2013), the EuroAfrica-ICT FP7 Awareness Workshop in Maseru, Lesotho (June 2012), the ‘2012 Africa-EU Cooperation Forum on ICT’ in Lisbon (Nov. 2012), the EU ICT 2013 event in Vilnius (Nov. 2013) and the ‘2013 Africa-EU Cooperation Forum on ICT’ / ‘African ICT Week’ as part of the AU 50th Anniversary in Addis Ababa (Dec. 2013). Such dissemination has also taken place at joint events with CHAIN-REDS, eI4Africa, UbuntunetConnect, AfricaConnect and a wide spectrum of other formal and informal events.

1.2 – Methods and Tools

The most important methods and tools used to select and implement the demonstrators are discussed in this section.
1.2.1 First Mile Initiatives

On the methodology side, one of the basic components is the First Mile Initiative (FMI) concept laid out in a proposal [1] to the UN Broadband Commission [2] via its Working Group on Science and Technology [3]. FMI is based on partnerships of Local Communities teaming up with local research and higher education institutions. The objective is to raise awareness of the benefits of ICT, to stimulate policy and regulatory dialogue leading to local support for development projects, etc. Such initiatives have proven to play important roles as drivers of the involvement of private sector via pre-commercial procurements [4] and social businesses [5] developing into commercial businesses as the local market develops.

1.2.2 Synergistic cooperation with other ongoing projects

Since there are no dedicated resources for demonstrator development allocated to the EuroAfrica-P8 project itself, synergistic cooperation with other projects has been sought. Examples include projects funded by the EU Seventh Framework Programme (FP7) as well as projects funded via other sources.

During 2013 we have had the opportunity to cooperate closely with some new support actions, including CHAIN-REDS, eI4Africa and iMentors. For the demonstrator task, this cooperation has led us to accept the Science Gateway concept [6] as a framework for some of the demonstrators and also provided an opportunity to hand over the demonstrators as a relay to be further developed and demonstrated also during 2014, after the end of this project.

1.2.3 Technology Transfer Alliance

An extra muscle used in the implementation of the demonstrators has been provided by the Technology Transfer Alliance (TTA) [7], an association of universities supporting involvement of their faculty members and students in useful development projects for academic credit. TTA supports its member institutions with development of pedagogical models and examination methods supporting problem-oriented, project-driven learning. TTA also works as a networking platform for defining suitable projects and forming of multi-stakeholder partnerships and funding required to conduct successful projects. Most of the demonstrators developed have been supported by researchers, teachers and staff from TTA member institutions. The first annual TTA workshop was organised in Dar es Salaam in February 2013 and a second workshop is planned for June 2014, also in Dar es Salaam. TTA is developing into a powerful driver of development.

1.3 – Selection criteria

The selection criteria for selecting demonstrator projects have been:

1. The topic has to belong to a prioritized area as discussed in section 3 below, with the additional criteria:
   a. That ICT should be a central enabler in the topic (vs topics depending more on domain expertise). On the infrastructure sides, the focus has been on broadband networks [8] and Internet of Things [9] while on the service side all sorts of services and applications, including those supported by mobile networks have been discussed.
b. Uniqueness (e.g. this is not a topic already sufficiently addressed via other initiatives).

c. Cross-cutting benefit (e.g. a demonstrator in one sector, area or region will have value for other sectors, areas, regions, communities).

2. Access to capable coordinators and consortia, well connected and with experience and knowledge that could create momentum and potential growth so that strong cases could be made for the ROI on the research and development. Since the project is too short to demonstrate this quantitatively, the discussion has been focusing on qualitative measures like uptake and potential impact.

3. We started fairly broadly with many demonstrators and merged or dropped a few to create rich and homogeneous demonstrators. This process is further commented as we describe the demonstrators in section 3.

4. Likelihood/possibility of finding a funding opportunity for the proposal. All sorts of funding sources have been explored, not only EU-funding.
2 – Topics

One mission of the 8th Africa-EU Strategic Partnership is to stimulate policy and regulatory dialogues about the role of ICT in the implementation of regional and national strategies towards internationally agreed goals, such as the Millennium Development Goals [10], Climate Change Mitigation and Adaptation goals [11], etc.

Our initial list of potential demonstrators is inspired by African regional and national poverty alleviation strategies, ICT development strategies and Climate Change Strategies. We have also considered priorities formulated by development cooperation agencies in the developed world, findings from earlier mapping projects such as FEAST, Erina4Africa, etc.

Our list of topics and potential demonstrator projects has been circulated and discussed widely during the duration of the project. The list converged rapidly to the following overarching themes and has since then not been challenged. There seems to be a strong consensus that these topics are the most important to support socio-economic development in developing regions up to and beyond the Millennium Development Goals. The list has been structured into the following main themes:

1. Governance, focusing on harmonisation of regional ICT-oriented policies and regulations and ICT for rural development.
2. Healthcare and medical research focusing on sentinel surveillance of diseases, emergency transports, drug management, access to health information via guidelines and decision support, remote consultation and continuing education of rural health workers.
3. Education, on all levels, focusing on making ICT infrastructure available in rural areas.
4. Environment, including monitoring in terms of observations, analysis and forecasts of weather, agricultural and hydrological parameters and capacity building in research and higher education institutions
5. ICT and Energy Infrastructure, focusing on under-served areas, mainly rural areas where there is little commercial interest due to lack of all sorts of supply chains and uncertain demand.

2.1 – Governance

Regarding governance, we have focused on two activities:

1. Regional cooperation on harmonisation of policies and regulations, e.g. by feeding input to joint AUC-EC-ITU activities like the Project for Harmonization of ICT Policies in Sub Sahara Africa (HIPSSA) [12]. The demonstrators involved in this activity is focused on telecom regulations advocating Open Access concepts [13], cross-border communication, infrastructure sharing and innovative use of radio spectrum, such as an enhanced license exemption and secondary licensing of TV White Spaces [14, 15, 16].
2. The relation between and performance of the national government levels (national, regional, local) when dealing with their ICT for rural development strategies, including mechanisms supporting transparency and public participation.
2.1.1. Regional cooperation harmonisation of policies and regulations

It has become generally accepted that ICT infrastructure is an enabler of economic growth and social development. Mobile networks have contributed tremendously to a general progress towards the Millennium Development Goals [17, 18]. Several studies concluded that there is a clear positive correlation between the availability of broadband infrastructure and economic growth [8,19,20]. The Internet of Things is a third infrastructure component that is expected to have an even more profound impact [9].

To support activities in the MDG Acceleration Framework (MAF), some bottlenecks in policy and regulation have been highlighted. Key questions addressed in this area include:

- Plans for the deployment and densification of the terrestrial communication infrastructure. A few countries, such as Rwanda and Kenya, are forerunners, while most countries are slow to remove obstacles for fibre infrastructure deployment and fail to prioritize the release of the potential associated with the existing infrastructure by regarding it as a utility rather than a profit generator.
- Policy and regulation for trans-border communication. Via the Kigali protocol conceived during the negotiations about licenses related to the EASSy submarine cable system, all countries, also landlocked, can get access to sea-cables. Similarly explicit policies and regulations for trans-border communication directly between neighbouring countries, rather than via Europe, would stimulate regional development.
- The national government endorsement and support to development of e-infrastructures for research and higher education institutions (NRENs) and the regulator’s use of their NRENS as experimental fore-runners without having to make commercial commitments.
- The progress regarding transformation from low volume/high price to high volume/low price to make communication affordable.

In order to get answers to these questions ironed out, we have dedicated elements of some of the demonstrators engaging policy makers and regulators in concrete questions requiring in-depth decisions, not only responses on an abstract policy level. Examples of this include:

- The Crosslink Initiative involving all stakeholders that are instrumental to opening up for transcontinental cross-border connections between West, Central and East Africa. The concrete question concerns access to infrastructure to interconnect research networks in East and West Africa for strictly non-commercial and time-limited demonstrations of the benefits of such a link [21].
- The East African Great Lakes Rural Broadband Research Infrastructure [22], extending the Serengeti Broadband network around Lake Victoria Tanzania-Kenya-Uganda-Rwanda-Tanzania and with links from Kigali to Goma and Bujumbura. Again, the concrete question concerns access to cross-border infrastructure.

The Lesotho Broadband Initiative intending to provide broadband connectivity within Lesotho, both to urban and rural communities, at acceptable cost. A community-driven approach and complementing the activities of the local mobile operator is being discussed. The short-term goal is to identify the stakeholders, to create local and possibly international awareness and recognition, and to demonstrate feasibility [23].
2.1.2. ICT for Rural Development Strategies

Obviously, governments at all levels have a responsibility for rural development, especially for providing basic infrastructure including ICT-infrastructure, and to stimulate the market development by clearly expressing their own needs and requirements, as users, from service providers to rationalize own work processes by taking advantage of ICT and to provide services to the citizens, including systems supporting transparency and public participation in political processes.

Many African countries have a large proportion of their populations living in rural areas that are under-served in many respects, including access to ICT infrastructure.

While the technical nature and business models of cellular mobile phone networks make their deployment and use possible with little government intervention, this is not the case for other basic elements in the ICT infrastructure, such as broadband networks and Internet of Things. The market forces do not get these markets established without public sector intervention.

There is a lot of research that has been exploring how to establish sustainable broadband markets in under-served areas, both in the developed and the developing world [24]. Success stories are worth demonstrating to raise awareness and activate key stakeholders in other areas.

Like all essential markets, ICT markets are made up of consumers, producers and regulators. In order to develop the markets, including the associated supply chains of all sorts, it is important that all actors are proactive and act rather than wait for the others to act. The main actors include 1) Policy-makers and Regulators, 2) Users/Consumers, 3) Providers/Producers. The principle to act rather than wait is especially important in rural and other under-served areas where producers of ICT services hesitate because they see large needs for investments, high costs and risks, uncertain revenues and little profit.

Some strategies that are demonstrated in our demonstrators, by presenting evidence, include:

- Consumers/users should act rather than wait. Commercial last mile connectivity, both for communication links and power grids, will come sooner rather than later if there is proof of sustainability provided by community based first mile initiatives.
- While all stones have to be turned to find paying customers contributing to the operational costs of the required infrastructures, investments are easier to raise if the first mile initiatives focus on basic public services such as healthcare, education and local administration, including support to local entrepreneurs, environment monitoring, climate change adaptation, etc. The public sector can pro-actively stimulate the private sector by development plans illustrating needs and requirements and conducting procurements. Iterative pre-commercial procurement is a useful concept in this context that is discussed more below.
- Innovation on the technical and business sides can make a major difference. Supporting innovation is essential.
- What the EC calls pre-commercial procurement [4] is a proven form for community-driven initiatives involving clear statements about needs, requirements and forms for public private partnership agreements, including financial conditions, transparency rules, etc. Local communities should be in the driver seat with local research and higher
education institutions supporting them with evidence-based advice stemming from transparent research and development efforts. The local research and higher education institutions would have no problem, in their turn, to get support from their global peers.

Concrete Lighthouse Demonstrators in this context are based on both successful and less successful results and experiences from, among others, the following TTA projects:

- Tanzania ICT for Rural Development programme in which the Serengeti Broadband Network was developed [25];
- The AGLARBRI [22] and LSBI Initiatives [23];
- The "Rwednet Kigali City Network" [26];
- The SomaliREN initiatives "Universities as Agents for Change" [27] and "Fibre for Peace" [28];
- The MAREN and University of Malawi fibre networks [29];
- EkoConnect, a city network interconnecting universities in Lagos [30]; and
- Establishment of African Internet Exchange Points in Mozambique, Rwanda, Zambia, Malawi, Burundi, Namibia [31].

2.2 – Health

Health has a prominent place in most development strategies and implementation plans, especially the Millennium Development Goals. The most commonly mentioned priorities in policy documents regarding ICT in healthcare include sentinel surveillance of diseases, secure and rational drug management, remote consultations and continuing education of rural health workers. The main diseases include both chronic and infectious diseases, such as HIV/Aids, TB, Malaria, diabetes and cardiovascular diseases. There is a well-documented need for health portals providing information about diseases, guidelines and decision support systems describing treatment procedures, associated essential drugs, etc.

Demonstrators addressing these issues are discussed below.

2.2.1. Rational Drug Management Application

Most African countries can save substantial economic resources by adopting more efficient drug management systems starting from a “wise list” of recommended drugs approved on the national level and harmonised regionally. One of the main challenges is the logistics involved in the distribution chain to support needs analysis, ordering, stock-taking, collection of statistics and analysis of consumption, feedback on effects and side-effects, preventing tampering with drugs and injection of faked drugs in the process, etc. Stakeholders include scientists in pharmacology and pharmacy, drug regulators, customs authorities, drug manufacturers and distributors, healthcare units, etc. Interested stakeholders have been identified in all parts of Africa. The drug budgets in Africa are often almost half the healthcare budget and there are huge savings to be made from a more efficient drug management process. Projects on rational drug management are in progress in several African countries. A demonstrator developed in this project using TTA resources include an Android tablet application automatizing the currently manual procedure for an efficient drug management process and prototypes for key
steps used in rural dispensaries in rural Tanzania [32, 33]. It is currently being field tested in the Bagamoyo district and is in parallel also integrated with the Community Health Portal presented above.

2.2.2. Search for Phyto-medicines

Search for Phyto-medicines is an interdisciplinary research effort including collection and biochemical analysis of plants to identify molecules that are potentially interesting for manufacturing of drugs. Research networks, such as NAPRECA, cooperate on research in this and related areas involving natural products focusing on plants from the rain forests, which have the largest biodiversity. Stakeholders include pharmacologists, scientists using DNA-sequencing, chromatographic analysis and grid-computing, drug regulators, drug manufacturers, industry developers, etc. This demonstrator was planned to illustrate results from similar research from other continents and motivate strengthening the research infrastructure resources for this kind of research in Africa.

Positive discussions to support the development of this demonstrator were held with the UNESCO-HP Brain Gain Initiative, eI4Africa, EU/FP7CHAIN-REDS and high performance computing centres in and outside Africa. Unfortunately there were too many obstacles to getting the key research groups involved in the development process and a demonstrator project has not materialized.

2.2.3. International medical Expert Seminars via HDVC

Exchange of experience and consultation between medical experts on an international level is an obvious integral part of healthcare systems in the developed world. An early demonstration of the potential in an African context was organised at the Erina4Africa project workshop in Lilongwe in November 2009, most likely the first HD-video conference ever in Sub-Saharan Africa except possibly South Africa [34].

Using high-definition video conferencing for this purpose makes the point that the transformation of the telecommunication markets from low-volume/high-price to high-volume/low-price and the lowering of cross-border communication barriers have to be accelerated to facilitate this. An affordable HDVC client based on commercial-off-the-shelf hardware and open source based components has been developed in TTA projects and is available at a CAPEX cost around €15k. This was demonstrated at the UbuntunetConnect week in Kigali in November 2013. Stakeholders include all actors in the healthcare and communication sectors. Unfortunately, however, sufficient bandwidth to the interested medical centres is not yet in place. This demonstrator will be handed over as a relay to the eI4Africa project.

2.2.4. Remote consultations in the referral chain

While the previous demonstrator focuses on communication between international peer experts, this demonstrator deals with consultations up and down the referral chain between primary health centres and local dispensaries at the one end and national referral hospitals at the other end. It emphasizes the need for development of work procedures in the healthcare systems to be able to take advantage of the very powerful support that ICT in general can
provide. Feedback on cases referred up the chain is an important part of continuing education of rural health workers. The development of this demonstrator is conducted by TTA members and has been merged with the development of the community health portal discussed below.

### 2.2.5. Community Health Portal

The idea of a community health portal has come up in many discussions. The specifications regarding content include information about health in general and selected diseases in particular, guidelines how to treat them, and decision support to decide whether contacting the healthcare system is necessary or not. Other aspects include multilingual support, multiple entries for health workers, patients and relatives, audio, video and text channels for communication between health workers and patients, transmission of data from sensors providing basic health parameters (pulsoximeter, ECG, etc.). Development of an open health portal has been identified as a priority and is included in an EU/FP7 proposal under development. Consequently, one of the demonstrators developed and demonstrated is a Community Health Portal [35]. The concept was demonstrated as an early prototype during the UbuntuNetConnect week in Kigali in November 2013, including the Drug Management Application discussed above. The development and demonstrations will continue after this project as part of other projects, indulging the eI4Africa project at the upcoming events in Lagos (March 2014) and Dar es Salaam (June 2014). The cooperation with the eI4Africa project has also made us adopt the Science Gateway concept as a framework for several of the Lighthouse Demonstrators, including the Community Health Portal [36].

### 2.3 – Education

#### 2.3.1. School Content Development

One of the main challenges in taking advantage of ICT in primary and secondary school education is the development of learning material in local languages. There are a few initiatives in this area that could be developed into demonstrators. The challenge has so far been to find driving coordinators. We recently found one at the Open University of Tanzania having a solid contact with the Ministry of Education and Teacher Training Colleges. We also have managed to attract seed funding for a project exploring affordable and manageable ways to provide rural schools with robust, low-power ICT infrastructure as well as power solutions, with power supply being an even harder challenge to take on than the involved ICT-elements. This development is set to start in January 2014.

#### 2.3.2. Continuing Education for health workers

This demonstrator is focused on continuing education and overlaps the health, education and communication sectors. The demonstrator would illustrate innovative ways to integrate learning via on the job-training by providing feedback mechanisms. This demonstrator was until recently planned to be part of the Crosslink Initiative. Since this initiative has been more challenging than expected, the continuing education of rural health workers has been merged as a component in the health portal discussed above and the target area has been redirected to Tanzania. The continuing education content is initially totally based on WHO guidelines and
mechanisms for feedback information about the outcome of cases referred up the referral chain.

2.4 – Environment

2.4.1. Development of Automation of observation stations and densification of the observation network

From the EuroAfrica-P8 perspective, this project started with discussions in our social network about a demonstrator illustrating the power of the Internet of Things. The Makerere University, who is a member of that network, had just received some seed funding from NORAD to develop a proposal aimed at capacity building of research and higher education in experimental meteorology, including the engineering aspects involved in automation and densification of the environment observation grid. The group of partners behind this project includes, besides Makerere University, also the Dar es Salaam Institute of Technology (DIT), the University of Juba and the University of Bergen. The five-year project includes four research components and an education component aimed at educating five PhD-students and the establishment of a relevant Masters-level program. The four research components are:

- Design and deployment of an affordable automatic observation station optimized for regional conditions and transporting raw data from sensors to a central repository to be stored in a standardized format. The spectrum of sensors involved should allow acquisition of synoptic weather parameters as well as key agricultural and hydrological parameters [37];
- Establishment of a weather data repository for each involved country serving both research and professional weather service agencies;
- Numerical data analysis and forecasting based on the Weather Research and Forecasting Model, WRF [38], which is supported by free open source software; and
- Weather dissemination methods targeting key users of weather data, including farmers and fishermen.

KTH supports the project, via the University of Bergen, with Internet of Things technology in terms of wireless sensor networks and uplinks from remote observation stations. In cooperation with the eI4Africa and CHAIN-REDS projects, a Science Gateway framework is being developed and the WRF open source software is being gridified [39].

Some of the earlier identified potential demonstrators discussed below have been merged into this demonstrator.

The project includes assembly and deployment of 70 observation stations, 30 each in Uganda and Tanzania and 10 in South Sudan. Deployment areas are yet to be determined but in Tanzania the UNDP project and the Serengeti Broadband Network Project are strong candidates.
Sensor node based on an integrated MCU, radio transceiver and ADC (right) and an ultracapacitor battery with charging solar panels (left). Fully loaded, the battery can keep the sensor node running for three weeks while reporting sensor data every minute, even without sun. With just a little sun, the system goes on indefinitely.

2.4.2. Drinking Water Quality

Monitoring, treatment and protection of drinking water quality is a priority all over the world. There are stakeholders interested in testing the recent progress in wireless sensor networks demonstrated above, but not yet a funding opportunity. We have earlier experience from cooperation with the Blantyre Water Board in Blantyre, Malawi, regarding a study on drinking water quality monitoring based on a first generation Wireless Sensor Network [40]. This demonstrator has now been merged as a dedicated application into 3.4.1.

2.4.3. Drought Management

Drought management is another high priority. It involves collection of synoptic climate and weather data extended with agro-parameters, such as soil moisture and irrigation systems. Most meteorological observation networks are too sparse and need to be denser. Again recent progress in wireless sensor networks can contribute to this and would provide a good demonstrator inducing regulatory dialogue on the communication side. Besides the technical solutions, there are also new models for engaging ordinary citizens by taking advantage of the experiences from Citizen Weather Observer Programs in different countries, involving both professional and non-professional networks, such as the transport sector, radio amateurs, the scout movement, etc. This demonstrator has been merged into 3.4.1 as a dedicated application.

2.4.4. Early Warning System for Landslides

At the other end of the spectrum from droughts are flooding and landslides with too much water in the soil. A lot of people are killed in such disasters. Such a demonstrator could be coordinated with the two previous ones and has finally been merged into 3.4.1 as a dedicated application based on the same collected data.
2.4.5. Farming Management Information Systems

A need related to the above, but with a wider spectrum, that has already been prioritized in the UNDG MDG Acceleration Framework (MAF), is the need for information portals for farmers - a specialized and localized refinement of forums like FARANET [41]. This is an excellent example of products that could be developed by entrepreneurs as mobile apps. The development of such a portal is added to the list of potential projects kept by the Technology Transfer Alliance (ttaportal.org). This demonstrator has clear connections to the Agricultural Information Resource Centres (AIRC) established by ONDP in the Bunda district in Tanzania and with the dissemination component of the UNDP demonstrator discussed in section 3.4.1.

2.5 – ICT and associated Energy Infrastructure

2.5.1. Affordable and Robust Green Rural Networks

ICT equipment in general has not been designed to be power-lean or to be powered from renewable energy sources as required in rural Africa.

A high-performance, low-power IP router that routes 700 kpps at 20W powered by 12V DC based on carefully selected off-the-shelf hardware and free open source software components has been developed in TTA-projects [42, 43] and demonstrated as part of the EuroAfrica-P8 demonstrations. The server could serve as a basis for local industry.

A still unfunded proposal has been developed to set up an academic incubator aimed at industrializing this router.

Another example of relevant technologies for rural Africa is the ultracapacitor battery illustrated below. Each of the capacitors in the battery has a capacitance of 3000F.

The solar driven high performance router (left) and the ultracapacitor battery with microgrid controller (right).

2.5.2. First Mile Fibre deployment

The cost of deploying fibre is dominated by the civil works involved. The fibre itself and the electronics to light the fibre is affordable for local communities. It has already been
demonstrated in developed regions that local fibre access networks in rural areas can be provided based on local social business models in first mile initiatives. Another demonstration of that kind is being planned in the Serengeti Broadband Network to connect a couple of Agriculture Information Resource Centres (AIRC) that UNDP is in the process of establishing. The purpose for deploying fibre all the way to the AIRCs is to facilitate HD Video conferencing between the centres for education and training purposes.

The planning for this demonstrator has already started and the deployment will be made during 2014.

2.5.3. Wireless Broadband Backbones and Access networks

While waiting for a more dense optical fibre grid, backbone and access networks based on terrestrial wireless links can be used. License-free spectrum in the 5 GHz band using Wi-Fi techniques is one alternative as demonstrated in Zambia by the Fraunhofer Institute, also a partner in EuroAfrica-P8, using the own-developed WiBACK technology [44]. An extension of the Serengeti Broadband Network to UNDP AIRCs, beyond the current fibre backbone. Using the WiBACK technology is in progress and will be completed during 2014. Connecting to the end of the fibre link in Bunda, six initial locations (schools, a church, a hospital) will be connected via the wireless links.

![Wireless Internet provided in rural Tanzania. The graph shows the elevation above the sea level.](image)

There are also demonstrators of the use of TV White Space spectrum in progress in South Africa, Malawi and Tanzania [14]. These demonstrators of how to use TV White Space spectrum emanating from the transition from analogue to digital television are based on the IEEE 802.11af and EEE802.22 standards. We are to some extent re-using plans made for the unsuccessful attempt to include these demonstrators of opportunistic communications in the DOLPHIN proposal submitted to EU/FP7 Call 10 Objective 2013.1.7 (d).
2.5.4. Energy planning tools and smart micro-grids

ICT and energy depend on each other. Lack of electricity is often a show stopper in African ICT projects. There is a need for solutions that avail electricity without increasing the already small African carbon footprint. While solar energy seems to be under-exploited, all sorts of energy sources need to be considered, especially renewable. Energy planners need to be educated and trained in using available planning tools.

The figure above illustrates the annual variation in insolation. The red curve is from the Nata Village in the Serengeti district in northern Tanzania while the yellow curve is from Stockholm. The data is fetched from NASA 10-year average measurements.

On the distribution side, the national grids are sparse and the energy losses are high for various reasons. Are smart local micro-grids offering shared investments with consumption-based business models a solution? Traditional power companies think not, while policy-makers
should be more open to innovation.

2.6 – Innovation and Entrepreneurship

Donors and financial institutions are increasingly supporting the inclusion of innovation and entrepreneurship in academic curricula and development of incubators associated with research and higher education institutions. A first case that has attracted considerable interest can be based on results already available from Technology Transfer Alliance projects (ttaportal.org).
3 – Calls to target and proposals submitted

During the EuroAfrica-P8 project lifetime the following proposals have been identified for submission. Four of them have so far resulted in submissions. Three of them have failed for reasons discussed below.

3.1 – African Union Calls


Two proposals were submitted in April 2012, one titled: “Micro Smart grid Solutions for Rural Communities and Evidence-based Energy Policy Development in East Africa” coordinated by Makerere University and one titled: “Regional Impact of Renewable Energy Technologies in Africa (RIRETA)” coordinated by Dar es Salaam Institute of Technology (DIT).

Both proposals were rejected on formal grounds without having been evaluated. The first one was submitted electronically in an unsigned version in time while the signed version arrived with postal service briefly after the deadline. The appeal was not considered. The second proposal contained a page from the Government of Mozambique that was not stamped according to instructions.

In the aftermath we have heard that the competition was fierce. There were 498 proposals submitted and only 20 were granted funding, a success rate of about 4%.

3.2 – EU/FP7 Calls

The two last ICT calls addressing the EU FP7/ICT 2013 Work Programme, Call 10 and Call 11 fall in the period of this task. In Call 10, a proposal, DOLPHIN, was submitted targeting Objective ICT-2013.1.7 (d) focusing on a FIRE test bed for emergency healthcare and healthcare services for under-served groups. African partners included CSIR and the University of Johannesburg. Organisations involved on the European side were KTH and KI from Sweden, Aalto University from Finland, UPC/I2CAT from Spain and Sigma Orionis from France. Strong support letters were received from several concerned regulators, Medecins Sans Frontières (MSF) and hospitals in Spain and Sweden, among others. In the review, the proposal did not reach the threshold. Although the call emphasised demonstration of social impact, the main criticism was that too little attention was paid to new technologies. Call 11 turned out not to include any open objective of relevance for our purposes.

3.3 – National Calls

A proposal titled “Establish a Low-Power Open Source Router Assembly Incubation Laboratory at Makerere University” was sent by Makerere University to the Uganda Communications Commission (UCC) in May 2012 in response to a Call for Proposals on Incubation Services. The competition was very high and the proposal did unfortunately not get funded.
3.4 – Calls from Donors and Financial Institutions

3.4.1. NORAD

A proposal to NORAD/NORHED with the purpose to reinforce the national meteorological services in Uganda, Tanzania and South Sudan was developed together with Makerere University, DIT, University of Juba, University of Bergen and meteorological institutions. This proposal was successful and the project had its kick-off workshop in Kampala in November 2013.

3.4.2. African Development Bank

A proposal was submitted to AfDB by the Makerere University titled “The African Great Lakes Rural Broadband Research Infrastructure Drug Management Application”. Partners include DIT, KIST, KI and KTH. This proposal was not successful.

3.4.3. WB Programmes

Expressions of Interest have been submitted to several calls from the World Bank involving reinforcement of institutional mechanisms for technology transfer between the research and higher education institutions and industry, including innovation, entrepreneurship and incubation. None of them has led to further proposals.

3.4.4. SIDA/SPIDER

SPIDER is a subsidiary of SIDA supporting ICT for Development. They have frequent calls for proposals for seed-funding grants. We would like to acknowledge our gratitude to SPIDER since we have been successful in receiving several such grants to facilitate travelling and procurement of equipment for demonstrators developed in the TTA framework for the EuroAfrica-P8 project, including the following, all involving the respective national Ministries of Health and other key stakeholders:

- Travelling grants supporting the: a) consolidation of the network operation centre organisation and extension of the Serengeti Broadband Network; b) the Rwednet Kigali city ring connection KIST/COSTECH, King Faisal Hospital, the Central University Hospital and the Telecom House where it is now becoming connected to Ubuntunet.
- Field testing in Tanzania, Uganda and Rwanda of the Drug Management Application (DMA) discussed in section 3.2.1 and the Community Health Portal discussed in section 3.2.5. We are hopeful that these seed-funded pre-projects will facilitate more substantial project funding on a national level in the involved countries.

3.5 – Other funding opportunities

Two other organisations that have substantially facilitated the development of demonstrators include the Technology Transfer Alliance and the Somali Diaspora in Sweden.
3.5.1. Technology Transfer Alliance

The technology Transfer Alliance (TTA) is an association of universities, open to any interested university on a global level that are interested in offering their faculty members and students to participate in useful development projects for academic credit. To make this possible in an academically respectful way, TTA contributes expertise on pedagogical models and examination methods based on problem-oriented, project-driven learning, peer learning and vicarious learning and curriculum development taking advantage of these models and methods. TTA also serves as a social network for external stakeholders that are interested in being project owners of suitable projects and sponsoring extra costs beyond what the TTA members can budget. TTA does not fund development as such but provides a cost efficient model to support development since faculty members and students are rewarded via different sorts of academic credit, as long as the projects can be used for academic research and education purposes.

3.5.2. The Somali Diaspora in Sweden

Somalians turn out to be the second largest immigrant group in Sweden. The diaspora is very actively supporting the normalisation of the Somali situation. Some diaspora members that are also alumni of Swedish universities have taken initiatives resulting in a Memorandum of Understanding between the SomaliREN group of nine Somali universities and KTH to cooperate on the establishment of a university network in Somalia according to the NREN model. SomaliREN has also joined the Ubuntunet Alliance. In the TTA framework, plans have been produced for the first concrete steps towards a SomaliREN network. The Chief Technology officer of SomaliREN has visited KTH to get training, city networks have been planned and equipment has been procured and shipped to Somalia to deploy a first city ring connecting three campuses in the city of Haregisa in the Somali land region. All costs in terms of travelling and equipment have been covered by the Somali Diaspora in Sweden.
Conclusions

The main conclusions from the Lighthouse Demonstrator Task of the EuroAfrica-P8 project are:

- Working on demonstrators targeting mainstream policies, strategies and implementation plans together with key stakeholders is an efficient method to stimulate development.
- The partners contributing to the task described in this report have not only stimulated development in general and Africa-Europe collaboration in particular, but also actively engaged in it, far beyond the scope of this project, and have engaged stakeholders in e-infrastructures and applications to get involved.
- A number of very good demonstrators are available, and have been demonstrated. Almost all of them will be further developed and demonstrated in other projects. Some of them will most likely develop into sustainably operational networks, services and applications.
- Potential demonstrators from many Sub-Saharan African countries have been identified and explored. Not all have been successful. Our experience is that, although there are various differences between the countries, East Africa is more dynamically developing its ICT infrastructure and usage than other parts of Africa, with the exception of South Africa.

The objective of this task to demonstrate return on investment in e-Infrastructures has been reached in a qualitative sense. The evidence is the engagement from the many local stakeholders demonstrating ownership and leadership and contributing with own resources to complement and extend the embryonic demonstrators that have been possible to accomplish in the EuroAfrica-P8 project framework. The needs that have been identified are obviously important and meeting them makes a substantial difference for the beneficiaries.

The project has contributed to progress towards and beyond the Millennium Development Goals in several cases. The most obvious one is the set of demonstrators that for various reasons have become focused on the same region, the Mara region, the poorest region of Tanzania. A critical mass has been reached that attracts more stakeholders. What initially was a simple proof of concept for affordable deployment of rural broadband networks has led to a sustainable network with a wide spectrum of services and an infrastructure contributing to the UNDP MDG Acceleration Framework activities in Tanzania.

Another less obvious example is Somalia where the incumbent president, Hassan Sheikh Mohamud, elected in 2012, was previously founding Dean of the SIMAD University in Mogadishu and a member of the SomaliREN group that in 2009 formed the "Universities as Agents for Change" and "Fibre for Peace" initiatives together with some Swedish universities and the Somali diaspora in Sweden, where Somalians are the second largest immigrant group. The development is much slower than in other parts that we have been active in, but is slowly picking up. A fibre network is being deployed in Discharge and a community health portal is being developed.

Anyway, the EuroAfrica-P8 demonstrators have spread awareness about several issues in policy and regulation, stimulated the debate on open access to infrastructure resources and also stimulated development of products and services that take advantage of unique African
resources and meeting unique African challenges.

There is, however, still room for more efficient innovation processes to increase the yield of the effort put into demonstrations like those described in this report. Some proposals to this end have been identified and discussed in this project and will be handed over to other projects, such as the already ongoing eI4Africa and CHAIN-REDS projects and the NORAD project on Automation and Densification of the environment monitoring grid in East Africa.

If we describe the challenges in market terms, the basic stakeholder groups include users/consumers and providers/producers. Since many of the markets involved are considered essential for society, they are regulated by policy makers and regulators. This goes for communication markets, healthcare, medical drugs, education, etc. An obvious way to increase the yield in the innovation process is to improve the communication between those that have needs and requirements and those that can develop technical solutions meeting the needs and make sure that policy and regulation is balancing the different interests. It is not as obvious how to do this efficiently. It is a matter of time-consuming awareness raising and education to get the users to express their needs and requirements in a relevant way and match them with the developers, providers and producers and to make the policy-makers and regulators create empowering regulatory frameworks.

Those that can do that are still in short supply, especially in developing regions. Since time is also in short supply, there is the well-known question about optimization of the use of time. Is it more efficient to educate the policy-makers, regulators, users, etc. directly, or should we focus on multiplying the numbers of educators? This leads to another potential stakeholder group that should be stimulated to step forward and are in the process of doing so in the Technology Transfer Alliance: Research and Higher Education Institutions.

This stakeholder group can also address the fact that all the needs require access to skilled human resources to find and deploy solutions, and some of the needs require the whole chain from research and development to innovation and entrepreneurship to find cost-efficient solutions meeting user requirements. Research and higher education institutions are thus important actors, but many of them badly need to improve their interface to innovation, industrialization, entrepreneurship and business aspects. Sustainable development has to be based on sustainable business models accepted by all stakeholders. Such business models grow out of a deep understanding between the stakeholder groups.

Research and higher education institutions have the advantage before other stakeholder groups to have a more neutral role to the market issues, based on logical reasoning rather than minimization of costs, maximisation of profit or taxation. The ability to live up to this role may vary between individual institutions, but in principle this is it. The neutrality and public good character of these institutions, together with the fact that their alumni can be found in all sectors of society, could make them a good agent for reflective change, if they can be stimulated to take on that role. Policy-makers and regulators can use them for experiments without making commercially binding commitments. This is a cost-effective method to be used in stimulating the research and higher education institutions to facilitate for their faculty members and students on all levels to participate in advanced development projects while learning for academic credit. The pedagogical methods behind this concept are well proven and include problem-oriented, project-driven learning in teams exploiting peer learning and vicarious learning from earlier teams. What still needs to be improved is the integration of innovation and entrepreneurship in the academic curricula.
References


[18] Leonard Waverman, Meloria Meschi, Melvyn Fuss, The Impact of Telecoms on Economic Growth in
Developing Countries


[20] Christine Zhen-Wei Qiang, Broadband infrastructure investment in stimulus packages: relevance for developing countries


[23] Lesotho Broadband Initiative, EuroAfrica-P8 report, June 2012


[28] SomaliREN KTH MoU www.ubuntunet.net/september2010#somalirenprogress


[32] The DMA Drug Management Application developed as part of a pre-study for the AGLARBRI project intended to mobilize local communities, documentation is available at: https://archive.ssvl.kth.se/csd2011/csd.xen.ssvl.kth.se/csdlive/content/aglarbri.html and https://archive.ssvl.kth.se/csd2011/csd.xen.ssvl.kth.se/csdlive/content/documents-0.html

[33] Jaran Eriksen, Jessica Nilseng, Lars L Gustafsson, Amos Nungu, Pia Bastholm-Rahnner, Dennis Mazali, Björn Pehrson, A cross-sectional pilot study assessing needs and attitudes to implementation of
information and communication technology for rational use of medicines among healthcare staff in rural Tanzania, Joint CHAIN-REDS/eI4Africa workshop in Kigali (Rwanda) during the UbuntunetConnect week, November 2013

[34] Kristina Groth, Bjorn Pehrson, Carenet–A Research Infrastructure for e-Health, Erina4Africa Workshop, Lilongwe, October 2010


[38] Weather Research and Forecasting Model, www.wrf-model.org


[44] WiBACK wireless backbone technology, wiback.org