SOME EXAMPLES OF REAL LIFE SMART HUBS

The following examples are extracted from ongoing work at the time of this writing under the overall umbrella of UN ICT4SIDS Partnership (#8005). To illustrate the diversity and range of possible application scenarios, Figure 1 shows four possible categories of simple to large and complex application scenarios in terms of services offered and the number of service providers. Examples of scenario categories are:

- S1: This category represents single business service by a single provider (hub). The users of SPACE can select more than 150 business services from health, education, public safety, public welfare and other vital sectors. For example, a user can select mobile health clinic as a simple scenario.
- S2: This category represents a "service bundle" by a single provider (hub). SPACE users can combine many individual business services to form *service bundles* that represent health clinics, digital community centers, smart towns, and small to medium smart enterprises.
- S3: This category represents a business service shared by multiple providers and can be used to model a large number of B2B scenarios such as Health Information Exchanges (HIEs) between different healthcare providers, supply chains and interagency services in governments.
- S4: This category represents service bundles between multiple providers. This scenario can be used to model large and complex projects such as interagency projects and large health exchanges within a state or country. The Smart Global Village vision falls into this category because it interconnects and coordinates different hubs from different countries on different business topics.

Figure 1: Application Scenarios from Simple to Large and Complex

The following discussion presents a few real life application examples from very simple to large and complex scenarios to support SDGs, based on the categories shown in Figure 1.

Scenario1: Mobile Health Clinics and a World Hypertension Center

Mobile Health Clinics, combined with the mobile computing technologies, have been highly effective in combatting HIV and malaria, improving maternal health, detecting and controlling hypertension, and reducing infant mortality in Haiti, Jamaica, Peru, El Salvador, Nigeria, Uganda, Pakistan, Sri Lanka, and the Philippines. In particular, location-based text messaging applications have been highly effective to attract young people to mobile clinics that provide informational, testing, and/or clinical services.

While there are many success stories about mobile clinics, numerous failures have occurred due to logistical issues (e.g., running out of supplies in the middle of nowhere), technology issues (no wireless signal in the area), procedural problems (healthcare professionals could not get visas on time), and social issues (some parents did not like their children to be invited to a clinic without parental consent).

A Mobile Clinic Support System (MCSS) is needed to address the people, process and technology issues and thus assure repeatable success of these clinics. A support system is needed that leverages the latest ICT developments to serve the physicians, the patients, the healthcare facilities, the suppliers of materials and the regulating authorities. Such a support system profoundly impacts the delivery of healthcare to different parts of the World and is of value to central governments, municipalities, cities, or NGOs (non-governmental agencies) with interest in operating MHCs around the globe. In addition, it can be offered with minimal technologies or sophisticated web and wireless support. Figure 2 shows a conceptual view of MHCs.

Figure 2: Mobile Health Clinics and Collaborating Support Systems

We are using SPACE to help plan mobile health support systems for remotely located populations that need urgent help. These systems are the *primary* healthcare method for countries like Southern Sudan where no established hospitals exist. Special considerations are also needed for mobile clinics in the Far East where remote populations can be reached only by boats. The SPACE patterns and advisors have been used extensively to generate plans for MHCs and MCSS.

ICT4SIDS Partnership is actively working with the World Hypertension League (WHL) to form a World Hypertension Action Group (WHAG) Center that supports a large number of Hypertension Clinics (hubs) by using a Telemedicine and mobile health clinic model. Hypertension is the most impactful Non Communicable Disease (NCD) and is of vital importance to SDG Goal3. Specifically, about one third of adults in most communities in the developed and developing world have hypertension and is the direct cause of deaths and crippling disabilities. The World Hypertension Headquarter, located at www.whag4all,org, provides the following capabilities that have been developed by using SPACE:

- *A Global Hypertension Database* that focusses on the developing countries and underserved populations (our goal is to capture 10 million blood pressure entries, primarily from developing countries).
- *Advising services* by hypertension specialists, doctors, nurses and other medical professionals who diagnose the hypertension illness and advise the patients.
- *Reporting and Business Intelligence services* by analysts who will use decision support and business intelligence tools for visualization of the patient data stored on the Global Hypertension Database.
- *Education and Training Services* for educating nurses, patients and other healthcare students.
- *Research Investigations* on a wide range of topics that span medical and business issues of value to underserved populations.
- *Collaboration and Partnership Opportunities* between different players (POCs, medical professionals, NGOs, educational institutions, data scientists, and medical researchers) involved in the World Hypertension Action group (Whag).

Scenario 2: Smart Agriculture Centers for Developing Countries

An e-Agriculture Center/Office is typically a physical location that provides a set of e-agriculture related services. For example, a small e-agriculture center in a remote area may provide basic e-agriculture services through mobile devices and a website for nearby farmers and populations. A larger e-agriculture center may provide additional services such as quality assurance and crop life cycle management. An even larger center may in fact be a smart global village of farmers from neighboring locations. An e-Agriculture Center can be customized for smaller or larger populations and may provide the following services:

- e-Commerce for Agriculture: allows the users to buy agricultural products over the web.
- eManagement for Agriculture: allows the farmers to manage the crop logistics and productions, etc.
- Smart Agriculture uses the KDAL (Knowledge, Detection, Adjustment, and Learning) capabilities such as the following:
  - GPS for Agriculture: provide location based *knowledge* and services to farmers (i.e., weather conditions in certain locations)
  - GIS for Agriculture: provide information and *knowledge* based on satellites and other GIS systems
  - RFIDs/sensors for Agriculture: use sensors or RFID devices to *detect* status of crops, etc
  - eServices for food safety: applications that help in the early *detection* of diseases (e.g., in potato fields) and contamination of drinking water
  - Wireless Technologies for Agriculture: inform farmers to adjust based on weather conditions, special sales events, etc. by using text messages
  - Machine Learning and Computer Controlled Device Applications for Agriculture
- Supply chains for food distribution: how to distribute food safely with minimum loss. These supply chains are very useful in food distribution to people in Africa and other distressed areas
- Agriculture support system: A comprehensive decision support system that provides capabilities for planning, engineering and management of agricultural resources

Figure 3 shows screenshot of an e-Agriculture Smart Hub for Togo (a small country in Africa). This Hub was generated in a half hour interview with SPACE and includes an administrative portal, an end-user portal and also educational and training resources. This Hub contains most of the aforementioned e-agriculture capabilities but very basic smart agriculture features are operational due to regional considerations. We are, however, plugging in the following smart agriculture capabilities in the e-agriculture hubs in Sri Lanka and other locations based on regional needs:

- Using wireless sensors, IoTs and GPS to make farms more "intelligent" and more connected through "precision agriculture" also known as 'smart farming'.
- Using Big Data that is from collected crop yields, soil-mapping, fertilizer applications, weather data, machinery, and animal health. For example, Precision Livestock Farming (PLF), sensors are used for monitoring and early detection of reproduction events and health disorders in animals.
- AI techniques such as machine learning, neural networks and pattern recognition by using neural networks can be used to collect data over time and learn if the plant growth is healthy or not.

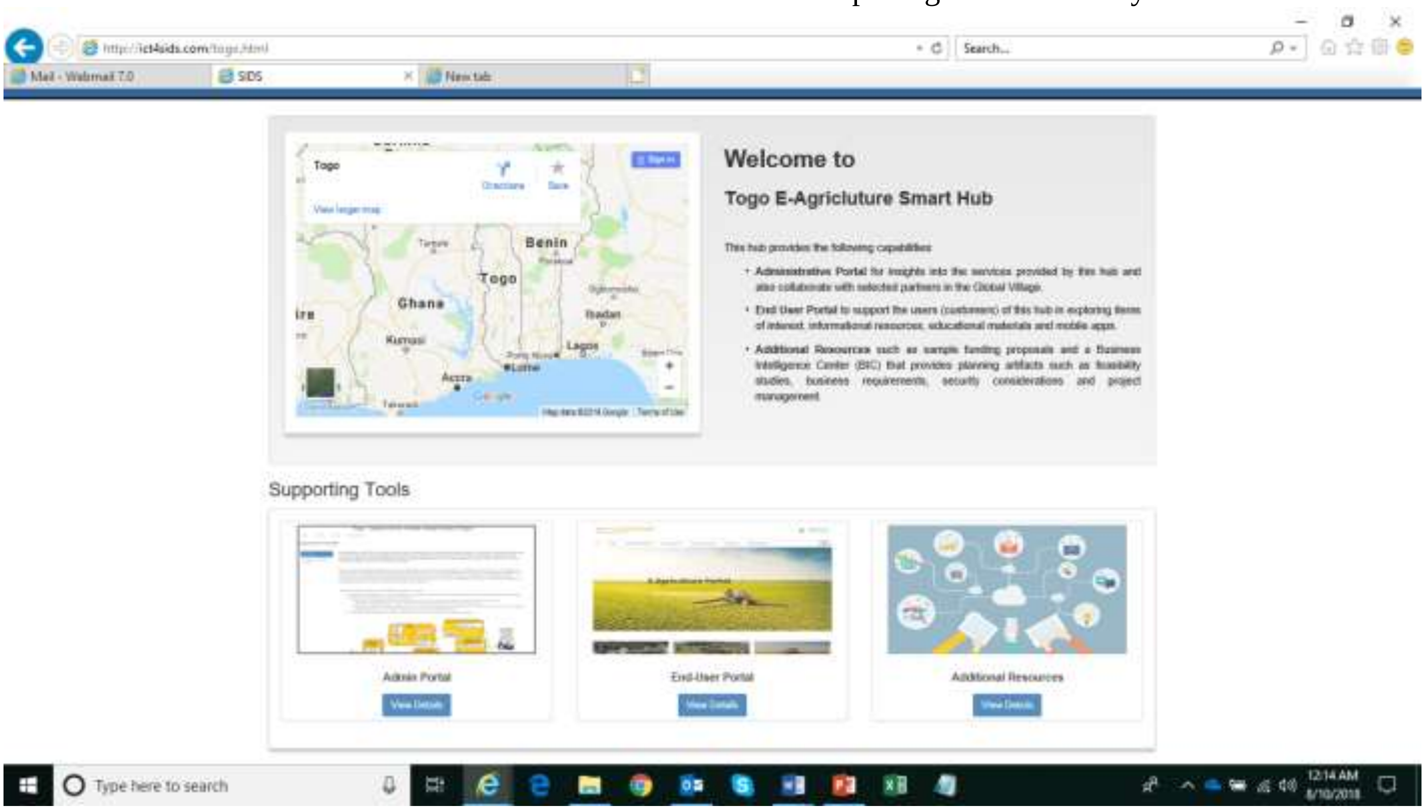

Figure 3: e-Agriculture Smart Hub Home Page View for Togo

III Scenario 3: Smart Community Centers in Small Islands

A Digital Community Center (DCC), also known as a Community Computer Center, is a place in a village, school, or city where the users can get access to needed services through ICT. In poor countries and areas where most people do not own computers, a DCC can become a hub of economic activity where people can access a variety of needed services by using digital devices and networks. The basic DCC service provides computer and communication infrastructure in a public place. Additional services may include government services, healthcare access information, basic computer education, vocational skills, information on government systems, bus tickets, market information, banking services, weather forecasts, legal advice, agriculture-related information, means of grievance redress, etc.

DCCs can also evolve into "Smart Communities" with capabilities to learn and adapt based on user populations. In Small islands, DCCs typically provide area specific capabilities such as fisheries and disaster recovery support. In most rural areas, a typical DCC looks like the following (see Figure 4):

- A physical site (a small building in a bus stop, gas station or rented rooms in a school) that are close to the Internet Backbone
- A solar powered micro grid for supplying power and communication capabilities through a satellite link
- Basic capabilities to support Skype and Microsoft Office
- A "Computer Room" with a small LAN of 10-12 Laptops/Desktops for access to health, education, agriculture and other vital information systems
- Rental of smart phones (Android, Microsoft, iPhones) for Mobile Apps
- A manager of the Hub, usually a high school teacher who works on a part-time basis

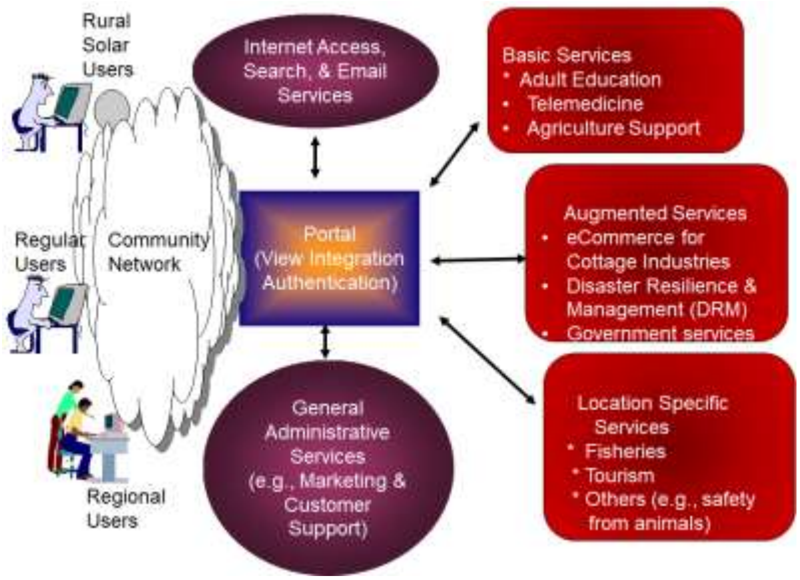

Figure 4: Conceptual View of a Smart Community Hub for Small Islands

SPACE provides extensive capabilities for DCCs in different parts of the world by extensively using the big data available about the area and then automatically suggesting the type of services needed in the area of interest. The POC further customizes the DCC based on local knowledge. Figure 8 shows an example of a smart community hub that was first created by SPACE for Solomon Islands and has since been replicated with minor adjustments for more than 10 islands. It can be seen that this hub supports users from rural areas to regional government personnel and provides health, education, disaster management, ecommerce, fisheries, tourism, and many other services needed by a community. Such smart community hubs provide tremendous public welfare and economic growth possibilities.

Scenario 4: Smart Global Village and the Global Center

A Smart Global Village (SGV) is a matrix of different hubs (columns) located in different countries (rows). The Global Center of the SGV is located on an IBM donated machine that provides central administration, analytics, and subject matter training and consultation services to all the hubs in the ICT4SIDS collaboration network. All smart hubs are being supported by portals generated by SPACE and the collaboration between different hubs is being supported by plug-ins that are automatically included in all portals generated by SPACE.

The SGV collaboration network supports a large number of collaboration scenarios. Figure 5 shows the collaboration model that is supported by the SGV – it captures the typical C2B, B2B, B2E, B2G and G2G communications between customers, businesses, employees and government agencies. This model specifically distinguishes between large and small businesses (B versus b) and between large and small government agencies (G versus g) that could participate in SGV. This model also introduces a network N of collaborators from the same agency (e.g., a physician's network or a state government network).

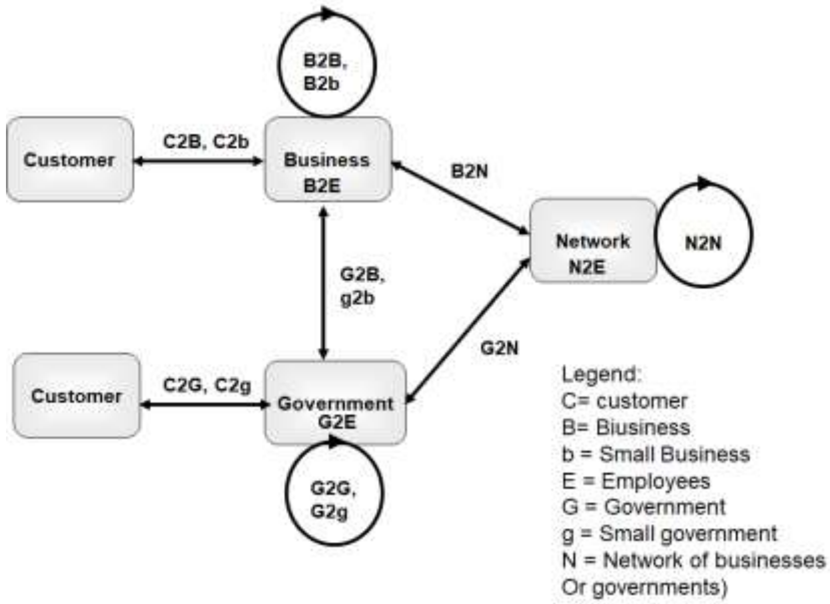

Figure 5: Collaborations between different Hubs