Smart Islands, Isolated Communities and Developing States

Smart SIDS present several unique challenges that are not commonly known to large metropolitan cities in developed countries. Consider, for example, the Solomon Islands that has a progressive government with a vision of "Smart Solomons". However:

- Solomon Islands has a population of 0.6 million people that is spread around 900 small islands in a 10,000 square mile (roughly 100 mile x 100 mile) geographical area in the vicinity of Indonesia.
- The populations in the small islands are so small that most of them do not have schools beyond primary education and virtually no healthcare facilities.
- The population is generally poor, with many people living in less than USD 100 per month and the working professionals make between USD500-600 per month.
- The telecommunications costs are extremely high (around USD1200 per month) for a 1Mbps (Broadband) line.
- The capital city, Honiara, is the only "developed" city with decent schools and healthcare facilities. But Honiara has only 15% of the population – 85% of the population is in the 900 islands.
- The islands are between 20 to 50 miles away from each other. It may take between 2 to 5 hours to transport a patient from an island to a hospital in Honiara.

A quick glance at Solomon Islands makes it clear that most of the smart city solutions are completely irrelevant to this situation. However, more than 50 small islands and developing states (SIDS) have similar situations. Suppose Smart Solomons wants to provide "smart" health and human services to its population. What does that mean? The SIDS government supports several sectors that span health, education, public safety and public welfare and each sector provides several services (see Figure 2). All the sectors should be interconnected through an ICT infrastructure and each sector also has its own internal ICT infrastructure to support its services, shown in Figure 2. Specifically:

- Which services in which sectors should be made smart? Large and complex systems (e.g., enterprises) consist of individual components and communication mechanisms between components.
- Small systems have few components, e.g., a small health clinic but large systems consist of many systems (systems of systems), e.g., corporations, cities, healthcare networks
- The components may be technology or human components.
- To build a smart system, individual components are smart (through KDAL) or interactions *between* components are smart (e.g., healing networks)
- People, processes, and technology tradeoffs must be evaluated carefully instead of piling up technology bags. In particular, KDAL features can be supported by people, processes, or technologies making tradeoff analysis necessary. Low technologies may be compensate through smart people and processes, However, if smart technologies are available, then less smarts are needed in people and processes.
- In developing countries, smart technologies may be available but not be suitable. For example, is it smart to build an automated smart system in Nepal that lays off 200 people (is it better to build smarts in people and processes?).

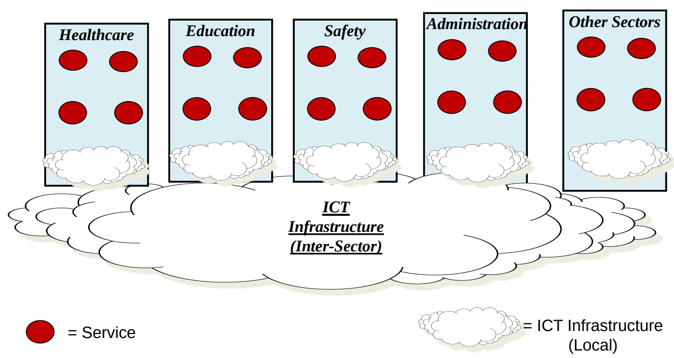

Figure 2: Conceptual View of a Smart Island

Addressing the Challenges – An Architectural Vision

Based on the aforementioned challenges and the guidelines suggested by the Samoa Pathway Declaration and the UN Sustainable Development Goals (SDGs), we have developed the architectural vision for Smart SIDS, shown in Figure3. Specifically:

- We strongly support the concept of ICT Hubs as stated in the Samoa Pathway Declaration, Section 109, Para h. These hubs are typically supported by a Portal. See Exhibit1 for an example of a typical rural ICT Hub.
- We specifically support the ICT Hubs that address different SDGs and collaborate with each other for high impact. Our hubs support SDGs 1, 2, 3, and 4 that pertain to poverty reduction, elimination of hunger, better healthcare for all, and access to education.
- Our implementation vision is a large number of collaborating ICT Hubs that support SDGs at local, regional and national levels and are managed by a Global ICT4SIDS Center, as shown in Figure3.
- The Global Center is located at Harrisburg University and resides on an IBM donated machine. The Global Center, as shown in Figure 1, houses large databases and coordination centers. It also includes planning, administrative, analytics, and training tools that provide central support for the ICT hubs at rural, regional and national levels in SIDS and LDCs. These capabilities are explained later.

However, implementing this vision is a non-trivial task for the following reasons:

- Where exactly to locate the Hub
- What type of services to provide for the area
- What type of energy and ICT infrastructure will be needed especially in the remote areas
- What are the national, regional and local security, privacy and cultural policy issues
- How to address the funding, business partnerships and capacity building issues

These are serious issues that must be addressed carefully. Unfortunately, many ICT projects are not considering these issues and are re-inventing the wheel leading to a failure rate of 60-85% due to expensive retries [4, 7, 12]. "Smart" projects are no exception. In addition, smart projects face more challenges due to numerous technical as well as business/management decisions that involve

- People, processes and technology tradeoffs (e.g., can well trained people and efficient processes/policies compensate for the lack of technologies especially in developing countries).
- Small versus large projects considerations (e.g., should all components of a large system such as a city be smart and can a smart "bus" between dumb components make it smart).
- Regional factors that differentiate smart systems in the developed versus developing countries (e.g., will a smart city in Nepal be the same as a smart city in Belgium).

Due to these reasons, we have developed a comprehensive computer aided planning, engineering and management environment, called SPACE, and a methodology to effectively use the SPACE environment – these are explained next.

Figure3: Overall Architectural Vision for Smart SIDS

Exhibit1: Example of a Typical Rural ICT Hub

- A physical site (a small building around a bus stop, gas station or rented rooms in a high school) that are close to the Internet Backbone.
- A solar powered micro grid for supplying power and communication capabilities through a satellite link with remote users
- 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 or tablets (Android, Microsoft, iOS devices) for Mobile Apps
- A manager of the Hub, usually a high school teacher who works on a part-time basis

Computer Aided Planning, Engineering and Management Environment

A powerful decision support environment is needed to address the aforementioned challenges. Such an environment should suggest a set of criteria, toolkits, frameworks and advise users about how to build a roadmap and self-assess the "smartness" objectives. Specifically, we have developed SPACE (Strategic Planning, Architectures, Controls and Education) – a comprehensive planning, engineering and management environment -- for smart services and enterprises in developing countries. SPACE satisfies all these requirements and is based on best practices, considers local factors through early warnings, can be generated within an hour at a very low cost and also suggests solutions that support KDAL. In addition, SPACE:

- Avoids failures due to reinvention of the wheel
- Generates detailed plans and solutions within an hour for cost that is suitable for the underserved sectors
- Supports a computer aided consulting model that can help launch a consultants without borders practice [8]
- Utilizes best practices and local factors through patterns
- Produces smart solutions based on people, processes and technologies tradeoffs

Most importantly, SPACE supports individual services that can be combined into complex "*service bundles***"** to represent offices, community centers, corporations and cities. This allows us to plan and architect very simple to very large and complex situations. Figure 3 presents a conceptual view of the SPACE environment. SPACE primarily consists of a set of intelligent advisors and games integrated around a common knowledgebase. These components are described below.

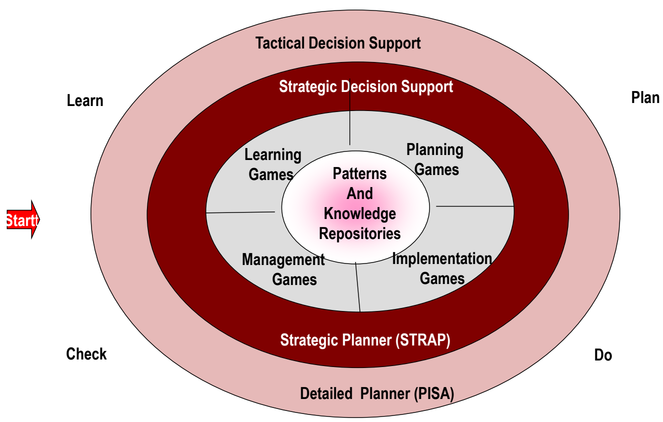

Figure 3:Conceptual View of SPACE

- **Patterns and Knowledge Repository** that captures the core knowledge needed by all SPACE tools. The pattern repository consists of industry patterns (e.g., health, education, public safety, public welfare, transportation), technology patterns (e.g., computing platforms, wired and wireless networks), operational patterns (e.g., security and integration patterns), and even country patterns (e.g., government patterns in different countries). [1, 2, 4].
- **Games and Simulations** that support decisions in strategic analysis, mobile services planning, security planning, interagency integrations and health exchanges, application migration versus integration tradeoffs, risks and failure management, and quality assurance.
- **Strategic Planner:** A strategic decision support tool for the IT officials in governments and the private sectors who need to strategically plan, architect, integrate, and manage the needed IT initiatives quickly and effectively by using the best practices.
- **Planning, Integration, Security and Administration (PISA):** A detailed decision support tool that can be used to quickly build real life business scenarios and then guide the user through IT planning, integration, security and administration tasks by using best practices and patterns.

The SPACE tools are at the core of systematic methodology discussed later. The results of this methodology are Smart Hubs that are managed by the Global Center that serves as the "Command and Control Center" for the ICT4SIDS Partnership. This site also serves as a Center for Collaboration between all hubs and provides the following capabilities shown in Figure4:

- *Collaboration Matrix* that supports different collaboration scenarios between different hubs and global centers. For example, telemedicine centers in Samoa and Solomon Island can exchange information with each other and also with a Nursing Education Center located in Aruba.

- *World Hypertension Center* located in Harrisburg can be used to store hypertension data from Haiti and Jamaica for across-country analysis and advice to populations in these islands. This center is being operated by the World Hypertension League and a healthcare NGO (Colleagues in Care).
- *Education Center* is available as the central repository of education and training for capacity building of different regions, especially in ICT. We are currently working with Tanzania to educate school teachers for effective use of computers in classrooms.
- *Smart SIDS* is a new initiative that is using the SDG Advisor and Computer Aided Planning to develop Smart SIDS. We are currently working with Solomon Islands on a Smart Samoa Pilot Project.
- *SDG Advisor* is available to all hubs and the Global Center users for quickly checking the SDG indicator for their regions/countries, receiving recommendations for the services that can improve the needed status, and even launch the needed services through a Computer Aided Planner, discussed below.
- Computer Aided Planner is a very sophisticated toolset, called SPACE, that conducts a feasibility study and produces a strategic plan plus a working portal for a proposed hub.
- *Business Intelligence Center* is a new capability that will be used by any of the hubs for analytics. .
- *Disaster Recovery* Center is currently not operational and is being designed for disaster situations.

Figure4: Screenshot of the ICT4SIDS Global Center (Website: www.ict4sids.com, section: Global Center)

Computer Aided Planning Methodology Used

For maximum benefit, we have developed and are actively using the following methodology, displayed in Figure 3:

- *Phase1*: We invite SIDS to Join a Smart SIDS Pilot Project that implements ICT Hubs to support health, education, public safety, public welfare, and other SDGs for Smart SIDS. We ask the interested SIDS to use the SDG Advisor to help them assess their needs and determine which SDGs should be addressed in the Pilot Project.
- *Phase2:* A Hub vision is proposed and a Pilot Project is initiated by a SIDS and a Point of Contact (POC) is appointed by the target SIDS. The POC is trained to use the SPACE computer aided planning tool to conduct an extensive feasibility study and produce a strategic plan, a funding proposal and a working prototype of the selected Hub(s) – all within a day.
- *Phase3*: The results of the feasibility study are studied/revised and a final hub is created in collaboration with the SIDS POC and local experts. The final hub is "registered" in the Collaboration Matrix shown in Figure 4 and also in the appropriate Center (e.g., a hypertension hub is registered in the World Hypertension Center).
- *Phase4:* The portal is refined for a production version. The results are published in a Donor Portal for attracting funding sources, business partners and system builders. Funding models accessible by this process include, public, private, or even "crowd sourcing" which allows individuals to contribute to specific projects. In this Phase, a production version of the portal is developed and launched.

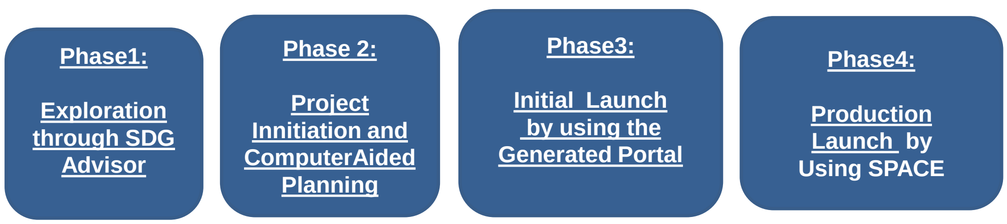

Figure 5: Computer Aided Planning, Engineering and Management Methodology

The objective of this computer aided methodology is to do more (provide more services to more customers) with less (less time, money and trained staff). Specifically, this methodology can save $50K to $70K per Hub, plus time (almost a year) and significantly reduce retries, errors and failures. These improvements reduce ICT risk, and therefore can attract greater participation by the private sector, which is key to accelerating the rate of value for SIDS organizations and individuals. The main advantage of this methodology is that the Pilot Projects get the SIDS POCs directly involved in all phases of developing the Hubs and thus develop valuable skills.

Main Results and Concluding Comments

Under the umbrella of UN ICT4SIDS Partnership we have launched 11 pilot projects that involved 6 SIDS. The aforementioned computer aided methodology and the SPACE environment has been used in all pilot projects. We currently have strong working relationships with many SIDS such as Antigua, Bahamas, Jamaica, Grenada, Maldives, Nauru, Palau, Solomon Islands, Samoa, Timor-Leste, and Vanuatu. The Ambassadors to UN and their staff from these islands attend the workshops and pilot project discussions frequently. As a result of this partnership, IBM has donated a large scale machine that is currently housing the Global ICT4SIDS Control Center, discussed previously.

We are primarily focusing on Smart Hubs to support Health, Education, Public Safety and Public Welfare related goals for Smart SIDS. The ICT4SIDS Partnership currently includes World Class Organizations such as the World Hypertension League (WHL) and Colleagues in Care (CIC). WHL and CIC are at the core of the World Hypertension Telemedicine Center that is housed at the IBM Machine on Harrisburg University Campus. This Center is actively working with Hypertension Hubs in Haiti and Jamaica because hypertension is the largest Non Communicable Disease (NCD) that contributes to deaths and disabilities in these two SIDS.

We have learned the following lessons during our work in the last two years:

- Implementation of World Hypertension Telemedicine Hubs address a very urgent need for SIDS and can be replicated quickly to other SIDS beyond Haiti and Jamaica.

- Computer aided Pilot Projects are essential for rapid deployment of large number of collaborating ICT Hubs needed to support Smart SIDS
- The first three phases (Phase1 to Phase3) of the computer aided planning methodology are a complete success with very promising and repeatable results (high value with low cost). In addition, the knowledge gained is fed back into the SPACE tool for future use
- Phase4 needs some work. In particular, choice of Point of Contact (POC) and Funding are the key challenges that are being addressed at present.
- The SPACE (Strategic Planning, Architectures, Controls and Education) is a very effective training and capacity building aid for SIDS because it allows hands-on planning experiments.
- We have also learnt not to declare victory too early or accept defeat too soon -- complex tasks take time and energy to succeed.

We plan to replicate and expand our network of hubs to many more SIDS in the next two years. The next major Smart Hub will focus on Disaster Recovery and Management (DRM) by using Sahana Open Source software. SPACE is currently being extended to support Sahana. We are also focussing on Phase4 issues by using the following approaches: First, encourage young entrepreneurs from SIDS to become POCs and help them start their own businesses. Second, connect the small existing hubs that are successful with larger more successful hubs by using ICT. Finally, keep refining SPACE Environment based on lessons being learned and use SPACE extensively for SIDS capacity building.

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