WHITE PAPER REPORT

REACH 2020

"Tele-reach for the Global South"

INTERNATIONAL SPACE UNIVERSITY

University of South Australia

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Faculty Preface

This White Paper represents the result of research by the 34 participants in ISU and the University of South Australia's 2012 Southern Hemisphere Summer Space Program, in which current and future tele-reach solutions, from the perspective of the socio-economic needs of the Global South were considered. The recommendations in this report are also critical to the delivery of essential services to a global community without regard to geographic location.

During the five week program, the participants from 12 countries examined the relationship between space and Information and Communication Technology. The area of research chosen for this White Paper reinforced the continued need for collaboration and co-operation of nations, especially for the nations located south of the Tropic of Cancer. Tele-reach systems rely on the need for sustainability, not only in information but also in access to the space environment.

We, the Faculty members and Teaching Associates for the project, recommend this White Paper to decision makers interested in exploring the synergy among space systems, terrestrial infrastructure, and tele-reach applications to maximize the use of information and communication technologies to address national and regional economic and social needs. Any nation in the process of developing a national space policy might find elements of this White Paper to be considerably relevant and it is thus commended in this respect as well.

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Author Preface

> *"The only thing that will redeem mankind is cooperation"*
>
> — Bertrand Russell

Reach2020: Tele-reach for the Global South is a report to inform decision makers on the core need for collaboration to address the challenge of sustainable development in the Global South.

Thirty-four participants from twelve countries attended the Southern Hemisphere Summer Space Program 2012 (SHS-SP12) to explore the interdisciplinary, intercultural, international, and intergenerational needs and opportunities specific to the Global South. *Reach2020* presents a mechanism to address the potential for increased connectivity among nations of the Global South, and the difficult task of sustaining progress. Specifically, we found that coherence through tele-reach for these communities is best achieved by collaboration at regional and national levels.

The scope and magnitude of this program would not have been achieved without the aid of our Program Co-Directors Scott Madry and Michael Davis, our White Paper Chairs Juan De Dalmau and Joe Pelton; faculty and staff Noel Siemon, Carol Carnett, Laura Drudi, Kristian Grayson, Antonio Yukio Ueta, Lesley Grady, and Mark Mackay. The team thanks the University of South Australia for providing host facilities and expertise for this program. Gratitude is also extended to all visiting guest lecturers and alumni.

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Mission Statement

"To develop a sustainable framework under which states can collaborate on economic and social needs, and maximize Information and Communication Technology (ICT) to provide space and terrestrial tele-reach applications"

R*each2020* is a White Paper that provides an in-depth survey of current and potential tele-reach solutions from the perspective of the needs of the Global South. This paper reviews the infrastructure, policy, and economic frameworks to enable the sustainable operation of these solutions. Particular emphasis is placed on the needs of regions and countries of the Global South to collaborate. *Reach2020* builds upon the 2011 ISU/UniSA Southern Hemisphere Summer Space Program (SHS-SP) White Paper that contained several viable space-related solutions to provide significant benefits in addressing current and future issues affecting the Southern Hemisphere.

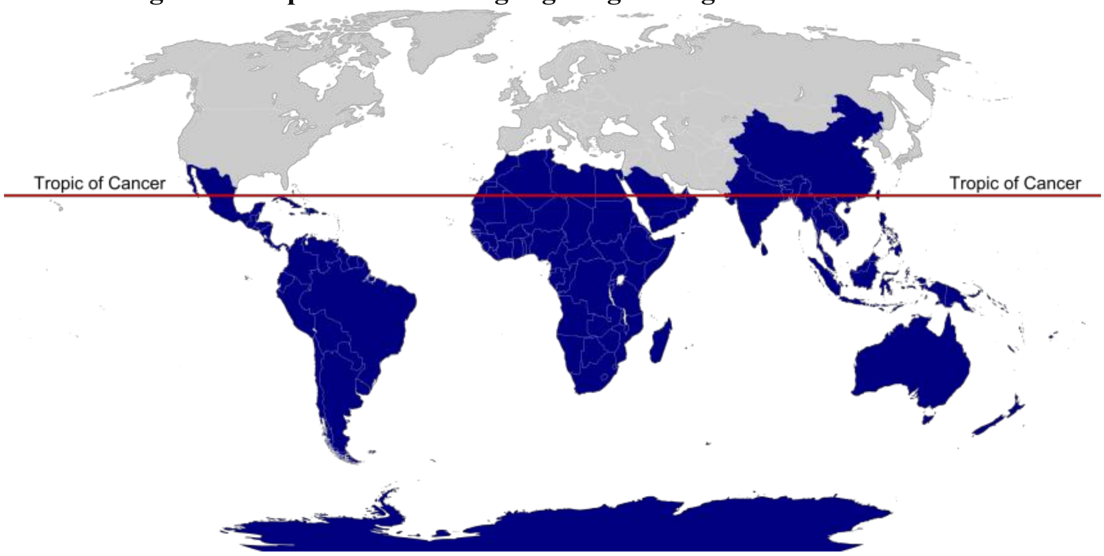
What is Tele-reach?

Tele-reach is a term that includes "…technologies and applications which allow remote presence, participation or interaction or control…" (Madry and Pelton, 2011) It allows people and organizations to complete tasks and activities at a distance, whether they are teaching a course, conducting a business meeting, performing a medical procedure, monitoring deforestation, or generating power. A synergy of ICT infrastructures enables tele-reach solutions.

What is the Global South?

The 'Global South' refers to all regions and States through which the Tropic of Cancer runs, as well as all regions and States below that latitude. This paper addresses the common challenges faced by the region, considering its inherent political, cultural, and socioeconomic diversities. In recent literature, the term 'Global South' is used frequently to replace the term 'Third World' in referring to "...the location of underdevelopment and emerging nations that [need] the 'support' of the global north. However, from the perspective of the inhabitants…, the Global South is the location where new visions of the future are emerging." (Levander and Mignolo, 2011)

Figure 1: Map of the world highlighting the region of the Global South



For various reasons the Global South struggles to achieve sustained and advanced economic development, provide reliable and extensive infrastructure, and operate effective political institutions. As a result, basic services such as education, healthcare, environmental monitoring, and civic engagement are less accessible, if available at all. Many Global South communities remain primarily rural, remote, and minimally integrated into the political or economic order of

INTRODUCTION

their country. While there are commonalities among the nations, they are also economically, politically, culturally, linguistically, and historically diverse, and vary in terms of scientific, technological, and epistemic progress (Grovogui, 2011).

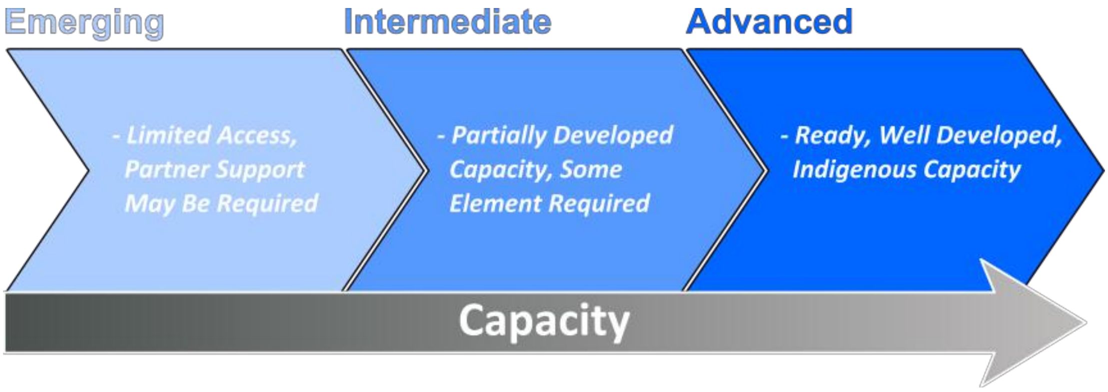
A Tiered Approach

To manage the complexity of comparing nations of the Global South, this paper employs a three-tiered approach to thinking about regions, countries, and communities in their capacity for tele-reach:

1. Advanced
2. Intermediate
3. Emerging

The paper briefly describes the ways in which these three tiers in Figure 2 differ from each other.

Figure 2: Three Tiers of classification



The Advanced Tier refers to countries or communities that are particularly ready and able to implement an advanced tele-reach solution. This means that they have well-developed capacity in technology, technical and scientific expertise, and access to necessary software and hardware. They also have reliable infrastructure, credible political and legal institutions, and predictable markets. The Advanced Tier will likely have indigenous capacity for technology and science.

The Intermediate Tier may have a combination of some of the above elements, but they may not be fully developed or entrenched, nor will there be easy access to all necessary resources. As a result, some tele-reach solutions may be too advanced or complex to be attainable or useful to these countries.

Finally, the Emerging Tier refers to countries or communities whose access to an indigenous capacity for technologies is limited or nonexistent. In addition, their political institutions and economic markets may be weak or unstable. Consequently, these groups may need partner support to implement basic tele-reach solutions.

This paper focuses on tele-reach applications from the perspective of the needs of the Global South. *Reach2020* describes the first viable step in a framework for tele-reach implementation – a tele-reach portal for regional and multinational collaboration. *Reach2020* proposes a Tele-reach Operational System of Systems (TeOSS) by 2015, with regional and international governments, and other significant partners linking in for collaboration. This paper proposes possible infrastructure, business, and policy models, and discusses legal issues; these will exist as the initial content on the portal. Implementation of *Reach2020* means full international collaboration by 2020.

Space technology is an essential tool to provide internet access to areas where terrestrial links are not available and space enables countries and communities to increase one aspect of their capacity for tele-reach. Space also can be key for broadcasting, multicasting, mobile, and remote services. Technical details and sustainability of the space environment are beyond the scope of this paper.

Space technologies are developed for many applications to improve quality of life. *Reach2020* addresses the impact on the inhabitants of the Global South, and adopts the premise that tele-reach opportunities and needs exist within and across each of the three tiers, and are not necessarily mutually exclusive. For example, in developed regions there are communities that still lack reliable internet access. Also, there is a need for advanced technologies particularly within Emerging regions - for example, medical care delivery to remote villages.

Figure 3: The Millennium Development Goals

(Source: UNDP, 2012)

Needs

A common problem among countries in the Global South is that rural areas need more attention because they are a significant distance from major urban centers and lack of resources. Integrated health and education applications delivered via satellite require limited reading skills by users and can help create an "essential health care culture". Each of the three tiers has different characteristics that determine their respective tele-reach needs.

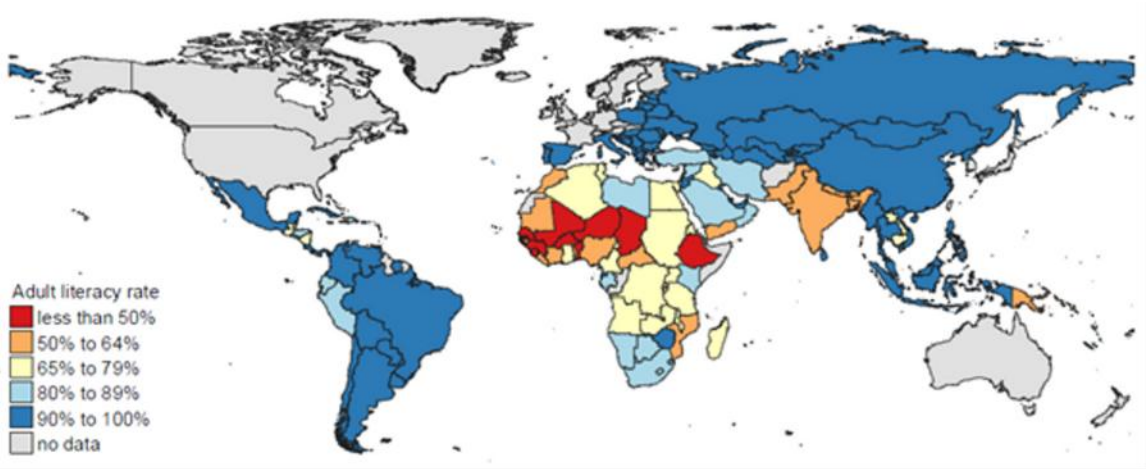
The United Nations (UN) has identified eight Millennium Development Goals (MDGs) as shown in Figure 3. Most of these goals would be addressed by providing underprivileged communities with timely access to basic information about personal hygiene, community health, food handling, disease management, and support infrastructure (UN, 2012). These goals guide the discussion on where best to recommend investment for tele-reach applications across the three tiers.

Nations in the Intermediate tier can use the MDGs to evaluate their degree of accomplishments and identify areas of further tele-reach implementation. Global Navigation Satellite System (GNSS) and Geographic Information Systems (GIS) provide data for benchmarking and re-evaluation of these MDGs. Feedback mechanisms can be devised for quick responses to essential societal needs. The Intermediate Tier can be achieved when the necessary infrastructure is implemented. International collaboration should be established to facilitate these applications and transition to the next tier.

ICT also enables tele-reach to expand our understanding of the world, and to manage our resources. With appropriate infrastructure, remote and real-time presence can enable operation and monitoring of a variety of applications. Developed nations in the Global South can take advantage of satellite services to supplement existing technologies as well as address disadvantaged sectors within their population.

Adult literacy is a requirement for advancement from the Emerging to the Intermediate Tier. Otherwise, even the most basic tele-reach solutions, such as using text messaging to distribute information, are rendered ineffective. Over two-thirds of the world's 793 million illiterate adults are found in only eight countries (Bangladesh, China, Egypt, Ethiopia, India, Indonesia, Nigeria, and Pakistan). Two-thirds of all the illiterate adults in the world are women. Extremely low literacy rates are concentrated in three regions, the Arab states, South and West Asia, and Sub-Saharan Africa, where around one-third of the men and half of all women are illiterate (United Nations Educational, Scientific and Cultural Organisation [UNESCO] Institute for Statistics, 2011). Literacy levels within developing nation provide a insight into other regional needs which may be addressed by tele-reach applications.

Figure 4: Adult Literacy Rate, 2009

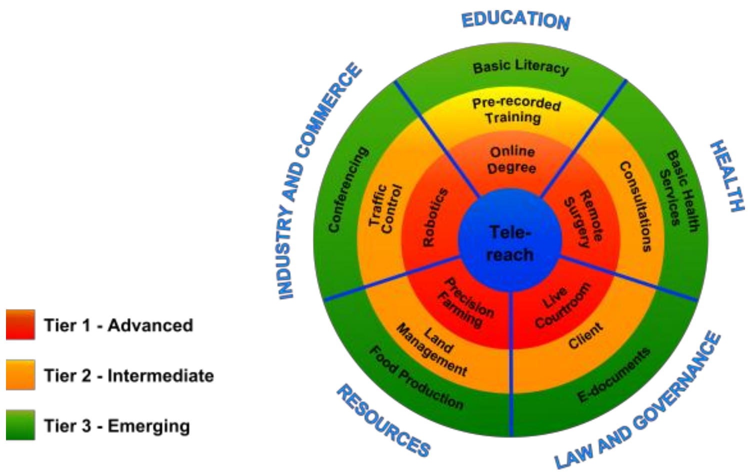


(Source: UNESCO Institute for Statistics, 2011)

Figure 4 represents the geographical location of many tele-reach needs and opportunities, especially for the Emerging Tier. The map highlights the potential for tele-reach to have an impact within the Global South. The tele-reach portal, to be described in greater detail later in this paper, will provide a database of lessons learned in using tele-reach to meet similar needs.

Applications

Figure 5: Relationship map of tele-reach applications



Any tele-reach application can be described in terms of its complexity (volume and rate of data transmission) and urgency (timeliness of delivery). Figure 5 illustrates specific examples of tele-reach applications, and the nested nature of the three tiers. The figure suggests some inter-dependence within this hierarchical system. It is important to understand in the context of infrastructure provision and general sustainability of any tele-reach solution. Basic tele-reach functionality is needed before progress can be made to the following tier. Figure 5 shows the relationship for each area for tele-reach from an Emerging capacity on the outer ring into an Advanced capacity in the center ring.

Tele-reach can be developed or enhanced, depending on the needs of the target community. Efficient ground, space, and user segments are needed to ensure sustainable tele-reach systems.

Conclusions
- Invest in basic educational tele-health for Emerging communities.
- Promote collaboration to exploit tele-reach opportunities for Intermediate communities.
- Enhance and expand high technology tele-reach potential for Advanced communities.

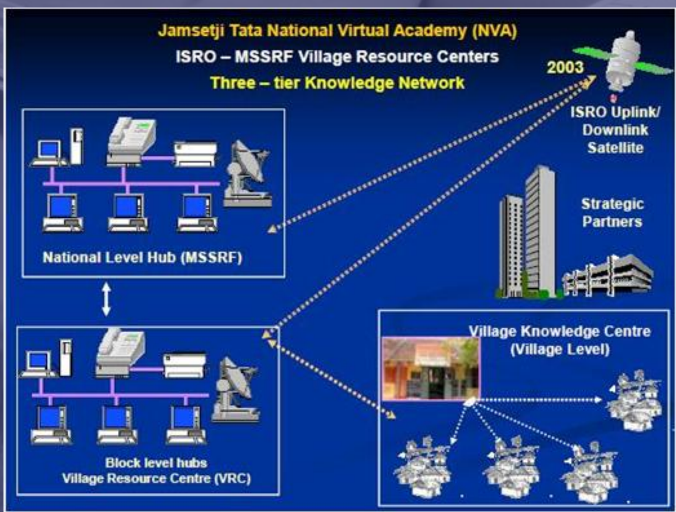
AT A GLANCE

Village Resource Centres of India

Village Resource Centres (VRC) are facilities developed for tele-reach applications established in rural areas of India. They work as modified libraries and information centers and provide expanded services to support Disaster Risk Management (DRM) activities. VRCs integrate space technology and terrestrial infrastructure to provide improved access to data on natural resources, land and water resources management, tele-medicine, tele-education, vocational training, DRM, climate change adaptation, health, and family welfare.

The basic cost to setup one VRC in a rural location is ~USD10000 (Council for Advancement of People's Action and Rural Technology [CAPART], 2006), plus costs of capacity building and training of the local community. Nearly 500 VRCs have been established in the country since 1989, and there are plans to have about 2000 installed by 2012 (Mercado and Ravichandra Rao, 1992; ISRO, 2007). The VRC infrastructure and dataflow components are shown below.

Figure 6: VRC Dataflow Schematics



(Source: M. S. Swaminathan Research Foundation, 2009)

One of the most important lessons identified from early VRC implementation was the incorporation of indigenous knowledge to mold the delivery of information to the end user (Mercado and Ravichandra Rao, 1992). The main objectives of the VRC program are to provide bandwidth, network, outreach, and sustainability for delivering interactive applications to remote areas in India.

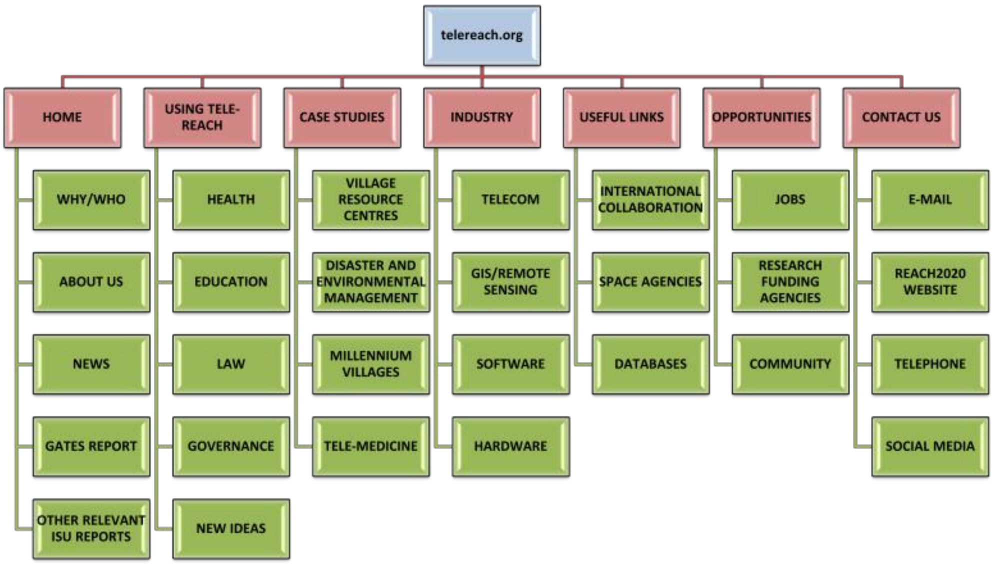
Within the Global South and the surrounding world, there are public, private, and collaborative partnerships that use tele-reach solutions to deliver products and services. However, these solutions are often working in isolation, which can duplicate effort and reduce their effective impact. *Reach2020* outlines important elements of tele-reach in the Global South and concludes that the existing network of satellites, ground segments, and user applications lends itself to a 'system of systems' approach similar to the Global Earth Observation System of Systems (GEOSS) concept. In this concept, experts from participating countries and organizations look at the various aspects of Earth observation with a view to avoid redundancies and fill in service gaps (EPAweb, 2012).

The Team recommends the development of the tele-reach portal, *telereach.org*, as this provides the first step towards building TeOSS knowledge base and resource center for governments, Non-Governmental Organizations (NGOs), businesses, individuals and other tele-reach communities. TeOSS is specifically proposed to identify overlaps and deficits in current applications and infrastructures. This will help ensure more efficient resource utilization and identify opportunities for further tele-reach applications and collaboration.

Reach2020 established a unique web-based portal for sharing experiences and information about tele-reach. The new website, *telereach.org* uses the proven and familiar 'wiki' model, which "…exists to provide a globally available, free (as in freedom, as well as money), encyclopedic (verifiable and unbiased) resource to everyone in their own language." (Beesley, 2006)

The tele-reach portal has links to different applications of tele-reach, the wide range of infrastructures used, developed business models, and critical policy decisions involved in successfully running tele-reach programs. Case studies are provided from Advanced, Intermediate, and Emerging Tiers. In the future, the portal it will include a catalog of vendors who provide hardware, software, and other services to enable tele-reach applications. The portal will have links to research institutes working on innovative ideas, upcoming conferences, books, recent publications, and funding support in different tele-reach domains including tele-health, tele-education, and tele-communication. The website will also host a discussion forum where experts can network, share their tele-reach knowledge and expertise, discuss their ideas, and provide links to other resources. Visitors can register for a bi-monthly newsletter to keep them well-informed of the latest updates and hyperlinks to live data. Contributions are welcomed from any interested party subject to approval by the website administrator. This procedure will help foster the creation of a worldwide movement dedicated to optimizing awareness of tele-reach opportunities and maximizing existing efforts. The basic information provided on the website is available in a number of different languages. Figure 7 shows the team's proposed website structure.

Figure 7: Layout of the Website



TELE-REACH PORTAL

The strength of this endeavor lies in the fact that it provides a range of inputs from many users; it is a collaborative approach to managing a common resource. The portal will identify and integrate diverse datasets and provide access to useful models and other decision-making tools. This repository of information could help inform and encourage entrepreneurs seeking business opportunities in existing tele-reach infrastructures or policy makers looking to develop solutions for their national or local needs. Vendors and suppliers can also use this tele-reach portal to promote themselves by providing relevant links to their products and services. Additionally it could be used by job seekers to identify potential job opportunities within the tele-reach industry.

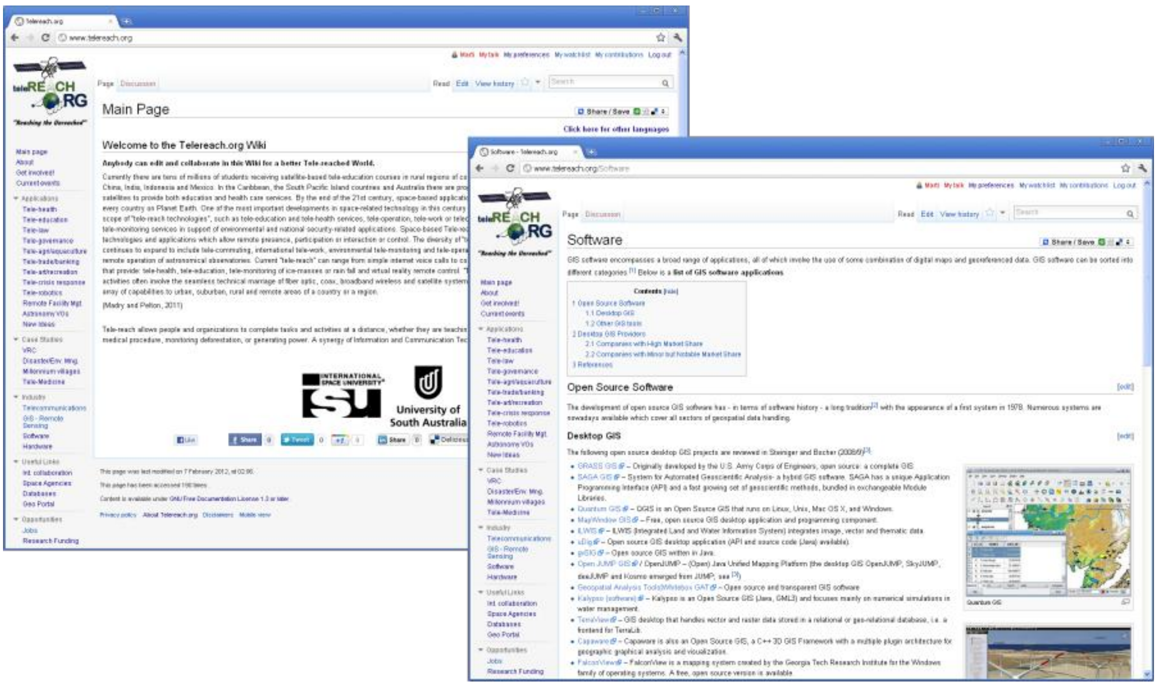
There are three main issues to be addressed in order to make this portal a successful endeavor. First, content needs to be generated on the website. Second, the site needs to be promoted among relevant stakeholders, which can be done by bringing together experts from different tele-reach domains in a series of regional conferences and workshops. Finally, the content needs to be kept up-to-date. The success of the portal will depend upon achieving buy-in from all relevant stakeholders in the concept of a central tele-reach portal and an eventual TeOSS.

The portal provides an access point through which governments and other agencies could promote their approach to tele-reach and link to their extant tele-reach project, providing a common point in which policy makers could access the latest activities occurring in the industry.

The team recommends that governments, as well as other significant agencies, provide a link from their respective websites to the tele-reach portal *telereach.org*, thereby giving decision makers access to the latest activity in tele-reach. It is also anticipated that the UN will create policies that validate this web-based framework, which would help to build its credibility. Ultimately, the web-based portal will act as a centralized information resource; a forum where decision makers, experts, industry, and NGOs, can network; and a starting point from which to launch the TeOSS.

The subsequent sections of this paper will discuss the supporting elements of tele-reach; these elements will form the initial content on *telereach.org*.

Figure 7: *telereach.org* Website



The tele-reach requirements for infrastructure are: power supply, data management, and bandwidth. Addressing these factors will minimize signal latency, maximize service reliability, and keep overall costs manageable. Infrastructure for communication technology focuses on the integration of existing satellite and terrestrial networks to provide support for a variety of tele-reach applications.

Infrastructure Requirements

Power

Given the limited power availability in some regions, access to a sustainable power supply is a critical design driver for tele-reach infrastructure as seen in Figure 9. Tele-reach programs for rural areas must be integrated with corresponding programs for increasing energy access.

Figure 9: Power for Infrastructure

Data Sharing and Storage

Efficient sharing and storage of satellite data for tele-reach applications is a critical component of infrastructure design. For example, the VRC program in India (Indian Space Research Organisation [ISRO], 2008) uses a central repository that can be updated automatically via satellite. The national nodes distribute data to regional centers based on local needs.

Bandwidth

Bandwidth requirements are driven by the type of tele-reach application, which, in turn, influences the cost. Generalizations regarding bandwidth and cost are difficult. Infrastructure must interface with older generation technologies, as well as provide the ability to use new technologies.

Latency and Reliability of Service

Many advanced tele-medical applications require reliable, time-sensitive information. To satisfy these advanced applications, any infrastructure must guarantee reliable communications with minimal delay.

Costs

Operational and maintenance costs must be considered when developing tele-reach infrastructure. CAPART (2006) estimated that the annual cost of operating a Village Knowledge Centre (VKC) in rural India in 2007 was approximately 488,500 Indian Rupees (~USD10,000). Infrastructure design should minimize this cost while providing adequate support for the selected tele-reach applications.

Terrestrial and Space-based Communication Systems

Infrastructure design requires a combination of satellite and terrestrial networks through an integrated ground network. The ground segment infrastructure can vary from direct links to complex networks. Combined satellite and ground networks can support a wide range of tele-reach applications.

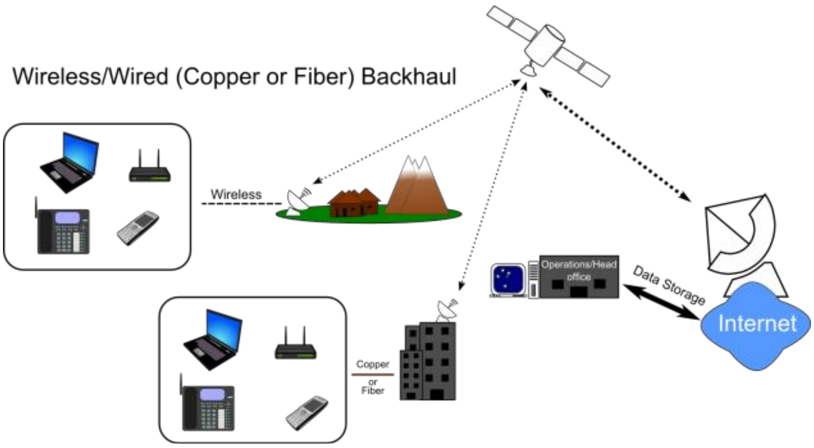
Backhaul

In satellite communications, backhaul is used to describe how data is transferred to a network distribution point as shown in Figure 10. Space-based telecommunications can provide a cost effective backhaul mechanism where remote locations have little to no ground-based networks because of physical connection and terrain limitations.

Internet Protocol over Satellite (IPoS)
This technology transmits all media types with high bandwidth and existing network compatibility. IPoS simplifies network interfaces, allowing infrastructure flexibility and adaptability (Intelsat, 2012; Bélisle, 2000).

Wireless Technologies
Fourth generation wireless technologies (4G) provide mobile services with substantial bandwidth availabilities. Emerging countries can implement basic tele-reach capabilities through the use of smart phones and tablet devices with minimal infrastructure requirements. Frequency allocation for these new technologies in an already crowded spectrum is a challenge still to be resolved (Naveh, 2009; Vilches, 2010; 3GPP, 2012).

Figure 10: Backhaul Network Components



Current Three-Tiered Situation

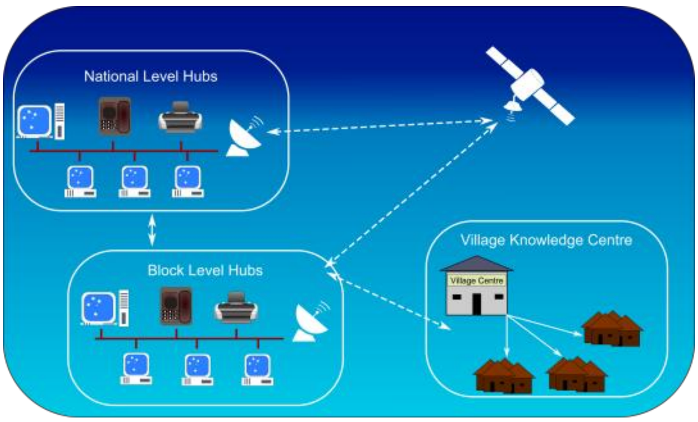
The distinction between the tiers is not absolute. Divisions also occur within countries, particularly between urban and rural areas. In China and India, population distribution is dispersed over wide geographical areas. Current tele-reach applications in China and India demonstrate capabilities at all three implementation levels (Figure 11). The creation of infrastructure for tele-reach capabilities is driven primarily by location and existing terrestrial communication systems, as illustrated in the following four examples:

China
Terrestrial fiber optic communication networks are distributed across its 31 districts. There are extensive fiber optic networks in major centers where national satellites distribute useful Earth observation data (MIIT, 2011; CCID, 2005).

China (Cun Cun Tong) - Village Access
The infrastructure used in the village access project provides access to remote villages to extend services provided by the fiber optic backbone for broadband and telephone services. These regions have access to national satellite distributed data. This distribution uses satellite based VSAT networks, and 2.5G/3G mobile phone networks (MIIT, 2011).

India
The infrastructure is composed of national and regional hubs. Internet is provided to all the hubs through the ISRO satellites (ISRO, 2008).

Figure 11: Layered Infrastructure Approach



(Source: Subramanian and Arivanandan, 2009)

Improving infrastructure requires additional bandwidth, hubs, and stand-alone power sources. The populated areas could benefit from new 4G technology, while remote areas could benefit from IPoS. A unique database, allowing storage and retrieval of programs across the entire network has been proposed (Hegde, 2009). This is a data integration concept that should be incorporated in all future infrastructure design.

Tiered Approach to Infrastructure

Tele-reach infrastructure varies based on application and the operating environment. Infrastructure can be as simple as a remote Very Small Aperture Terminal (VSAT) or as complex as a full satellite network supported by fiber optics. Technology today provides an immediate, efficient means of connecting remote areas, with flexibility to develop more complex tele-reach applications. This approach allows countries to use tele-reach applications with existing infrastructure and provides a roadmap for future development. A greater understanding of how to use existing infrastructure and where to invest in new networks can be garnered from the experiences shared on the *telereach.org*.

Conclusions

- Enhance existing wireless infrastructures to enable tele-reach applications for smart devices in remote areas.
- Resolve the spectrum allocation process for new generation wireless technologies.
- Integrate data services, satellite, and ground communication networks at the initial design stages for tele-reach applications.
- Advance sustainable and renewable energy technologies to provide the infrastructure support for tele-reach applications in locations that were not previously accessible.

Case Study - O3b Networks Ltd (O3b)

O3b is a company intending to launch a constellation of at least eight satellites by 2013. The constellation is designed to provide connectivity for emerging and insufficiently connected markets, as shown in Figure 12. O3b could provide affordable connectivity for tele-reach applications if they are in one of the available spot beams (Network Strategies, 2010). O3b intends to provide intermediate links to connect infrastructure backbones where fiber optic networks are not available. O3b will use a mid-Earth orbit that has lower latency (O3b Networks Ltd., 2008) than the higher geostationary orbit, but increased complexity of the ground infrastructure.

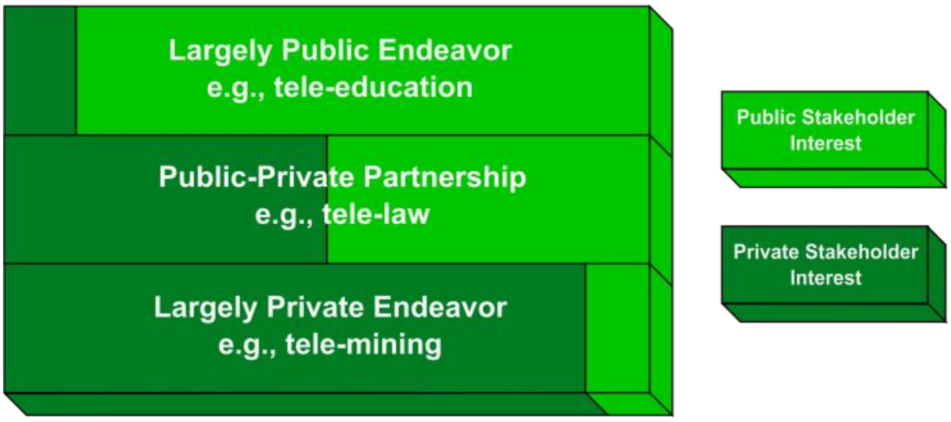
Figure 12: O3b Satellite Constellations and Coverage

(Source: O3b, 2012)

This section describes the different business model options available for a tele-reach application. A variety of factors affect the selection of a suitable model. Commercial involvement is key to the ongoing success of many applications.

As shown in Figure 13, the stakeholders for commercial applications are largely private companies that will gain a significant Return on Investment (ROI) (Investopedia ULC., 2011). There are a number of applications that will require a combination of either private and public stakeholders, or a Public-Private Partnerships (PPP) (Australian Government, 2011). Other applications that are not commercially viable may be funded and owned by the Government and NGOs.

Figure 13: The business models applicable to Tele-reach applications



Types of Business Models

Private Investment

For applications with an ROI, a private business model can be adopted. These applications could be implemented more effeciently with a lower total cost of ownership.

In the case of tele-mining, a solution to remote control mining equipment via a dedicated network could be easy to fund and implement, as the resulting cost reductions are significant and quantifiable.

Public-Private Partnership

PPP is a partnership between government and private enterprises. Multiple PPP models exist, including private design and funding in exchange for long-term government contracts and government funding, which later leads to commercial involvement (Australian Government, 2011).

Public Funding

Public funding plays a major role for tele-reach applications, as the majority of applications provide social, rather than economical, benefit, and attracting private investment is difficult because the economic benefits are not quantifiable.

In India, both central and state level governments have been the major source of funding for education. In 2008, the Indira Gandhi National Open University (IGNOU) began its tele-education program. To date the program has expanded to reach students in Africa. The project is funded by the Indian Government (IGNOU, 2012).

O3b has received investments of USD65 million from Google, Hong Kong and Shanghai Banking Cooperation (HSBC), Liberty Global, and Allen & Company, which is expected to increase to USD180 million. In addition O3b has secured financing support of around USD1.2 billion from bank financing in various forms of debt and equity (O3b Networks Ltd., 2012).

Model Selection

To choose a suitable business model, a point matrix can be constructed based on a number of factors, including level of profitability, social benefits, level of coverage, availability of infrastructure, availability of technology, and funding sources. These factors directly relate to the three-tiered approach to developing tele-reach application. For example, the availability of infrastructure and the availability of technologies relate to the capacity of a country to implement tele-reach.

Figure 14 below was developed from an industry perspective, hence profitability is ranked highly because a large ROI is desired by private investors. Since the matrix below has been modified to a private sector perspective, the higher the social benefits, the lower the total score. Multi-national coverage is easier for business to implement than government. The available infrastructure and technologies allows implementation to be easier and less risky for investors. No funding from government results in a higher score, as the only way to fund the project is through the private sector.

Each factor is then weighted based on the level of importance, where profitability and social benefits are ranked highest. To use the matrix, the user assigns a score out of 10 for each factor, based on the guidelines explained above. The scores are then multiplied by the respective weighting for each factor. The total points are used to determine the appropriate business model. The higher the total score the more it reflects the favorability for private investment. Any score below 30 points is better suited for public investment; from 30 points to 60 points, PPP, is more appropriate; above 60 points is more favorable for private investment.

Figure 14: Factors and Weighting Guidelines

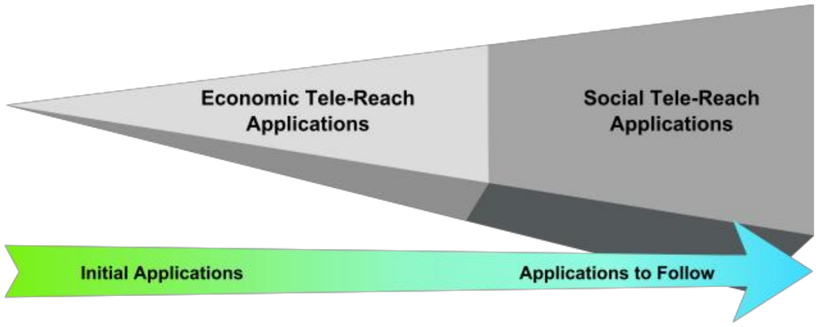
Factor	Weighting
Profitability • 10 - Highly Profitable • 5 - Break even • 1 - Large losses	3
Social Benefits • 10 - No social benefit • 5 - Benefits a small number of people in a small way • 1 - Benefits lots of people in a large way	2
Coverage • 10 - Multi-National • 5 - Regional • 1 - National	0.5
Availability of infrastructure • 10 - Infrastructure exists and is operational • 5 - Infrastructure is planned and will be available • 1 - No infrastructure available to support application	1
Availability of technologies - Non-space related technological components • 10 - All the technology exists and is in use elsewhere • 5 - Some of the technology exists but is rarely used • 1 - Technology does not exist	0.5
Availability of other funding - NGO's, IMF, etc • 10 - No other funding exists • 5 - Partial funding exists • 1 - Full funding exists	1
Availability of Government funding • 10 - No Government funding exists • 5 - Partial Government funding exists • 1 - Full Government funding exists	1

Industry Involvement

Industry involvement is essential, as it drives innovation and efficiency. Industry is also important for the sustainability of tele-reach projects. The majority of countries in the Global South are still developing indigenous technical and financial capabilities. These countries struggle to find the necessary expertise and funding within the Global South to carry out the development phase of any given tele-reach project. This challenge can be addressed by promoting collaboration between the Global South and existing tele-reach industries, NGOs, development agencies, and banks of the Global North. Opportunities for partnerships and cooperation could originate on *telereach.org* or by the introduction of a tele-reach industry policy program. The following policy areas will support tele-reach industry development:

Tax Incentives
Government grants and tax incentives are used to encourage entrepreneurs to locate within the Global South. This will provide companies with the assistance to create new highly skilled jobs and build a strong foundation for the tele-reach industry.

Figure 15: The thin end of the wedge



Encourage the Migration of Expertise
A panel of companies with tele-reach experience and skills will be established to ensure that the applications are delivered in a timely, cost-effective manner and that the projects are awarded to companies investing in the development of industry in the Global South.

Exchanging Ideas Through Dialogue
Tele-reach can be promoted through the funding of conferences to create opportunities for all the parties to meet and exchange ideas, in addition to the forums on *telereach.org*.

Integrated Services
As shown in Figure 15, an option for a sustainable business model initially requires implementing applications that have an economic focus and that generate a return for investors. The infrastructure provided to support these applications can then be used as the framework for applications that are focused on social needs.

Seed Funding
The costs to develop social tele-reach applications could be funded in part by NGOs, or charitable organizations such as the World Bank Organization. The seed funding provided by NGOs should be matched by private investment. Private investors will then recoup their investment by selling access to the applications as a service, which is paid for by long-term contracts with governments and NGOs.

Brand Awareness
Advertising space will be provided within tele-reach applications for companies to promote their brands and increase visibility in these new and growing markets.

Conclusions
- Develop industry policies to ensure that tele-reach applications are delivered in a timely, cost-effective way.
- Encourage private investment to ensure the economic sustainability of tele-reach applications.

This section examines policy, legal, and administrative challenges involved in the implementation of tele-reach on a national level. Lessons learned from regional and international cooperation during tele-reach programs are discussed, with the tele-reach portal existing as a mechanism for on-going collaboration. In the future, the portal could act as a resource for the creation of individual national policies.

Governance and policy are crucial to tele-reach program outcomes, regardless of tier. Efficient data sharing among partners and government departments increases the effectiveness of tele-reach projects, as illustrated in the Deforestation Monitoring Program in Brazil (p.23).

Without a national government policy on tele-reach applications, multiple policies are generated, causing duplication of effort and reduced data sharing between government departments. An example is the Canadian Medical case study (p.21).
To ensure sustainable long-term success of tele-reach programs, the following administrative factors should be considered:

- Staff training for implementation
- Education at all academic levels
- Public outreach

Governance of tele-reach programs can require coordinating multiple national and international aspects in line with the three-tiered approach, and all facets must work efficiently toward an effective outcome. This can be a complicated task, but a great deal can be learned from others' experiences, which could be shared in the discussion forums on telereach.org.

Partnerships in the developed world are often strongest among English-speaking countries and European countries, whereas developing-world links are comparably weak. Past collaborative work between countries can enable innovative collaboration approaches for tele-reach (Barlow, 2011). Frequent policy reforms are necessary to enhance innovation for sustainability and equitable development of tele-reach (Ely, 2010).

National Space Policy and Future Directions

A national space policy or direction informs policy guidance within countries. It also provides insights into national priorities, and enables other nations to identify cooperative opportunities and benefits. An increasing number of nations are developing space policies and strategies for sustainable socio-economic development – an approach that will also foster confidence in the local industries to participate in space activities (Williamson, 2012).

Key elements for a national space policy or direction include:

- Weather and Earth Observation
- Satellite Navigation, Surveying, and Map-Making
- Science, Technology and Innovation
- Energy and Natural Resources
- Agriculture, Forestry, and Fishing
- Telecommunications
- Education
- Health Care
- National and Regional Defense
- Infrastructure and Land management
- International Collaboration and Cooperation

Governments use information from these areas to inform decision making on issues of national importance, which can be linked with the implementation of tele-reach programs.

Without investment of sufficient resources, the goals and aspirations of a national space policy are not achievable. A formal statement of governmental intentions in space also clearly defines which departments of the national government are responsible for different elements of the overall policy. Finally, a national space policy or direction promotes coordinated action within a national government and also allows for development of regional and international cooperation – perhaps, eventually, throughout the Global South and even beyond. Such an example is the *National Space Policy of the United States of America* (Pike, 2010).

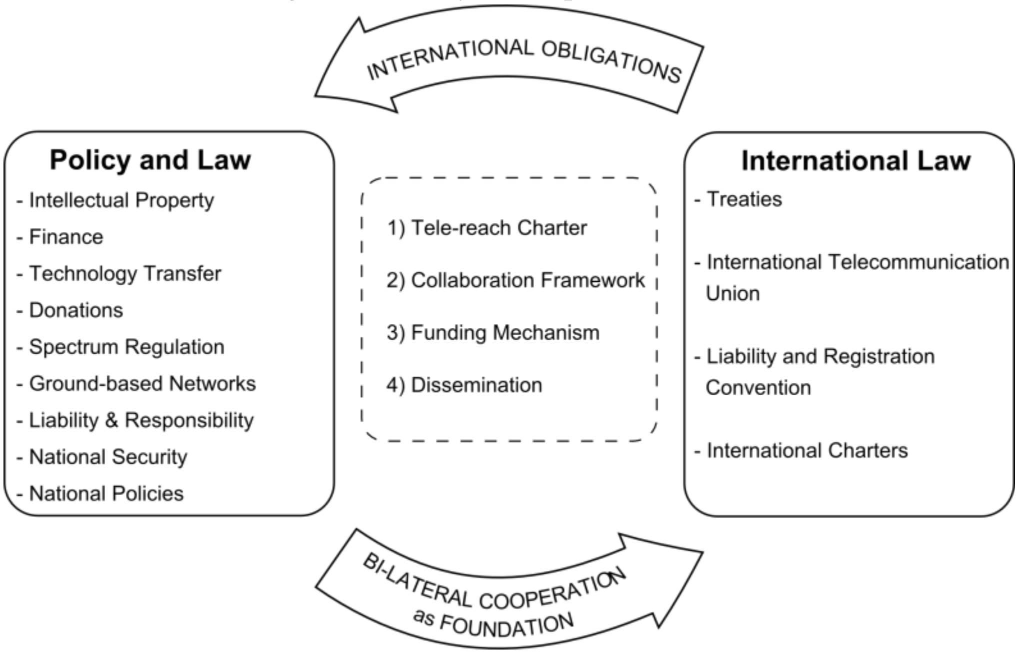
Interdepartmental Cooperation

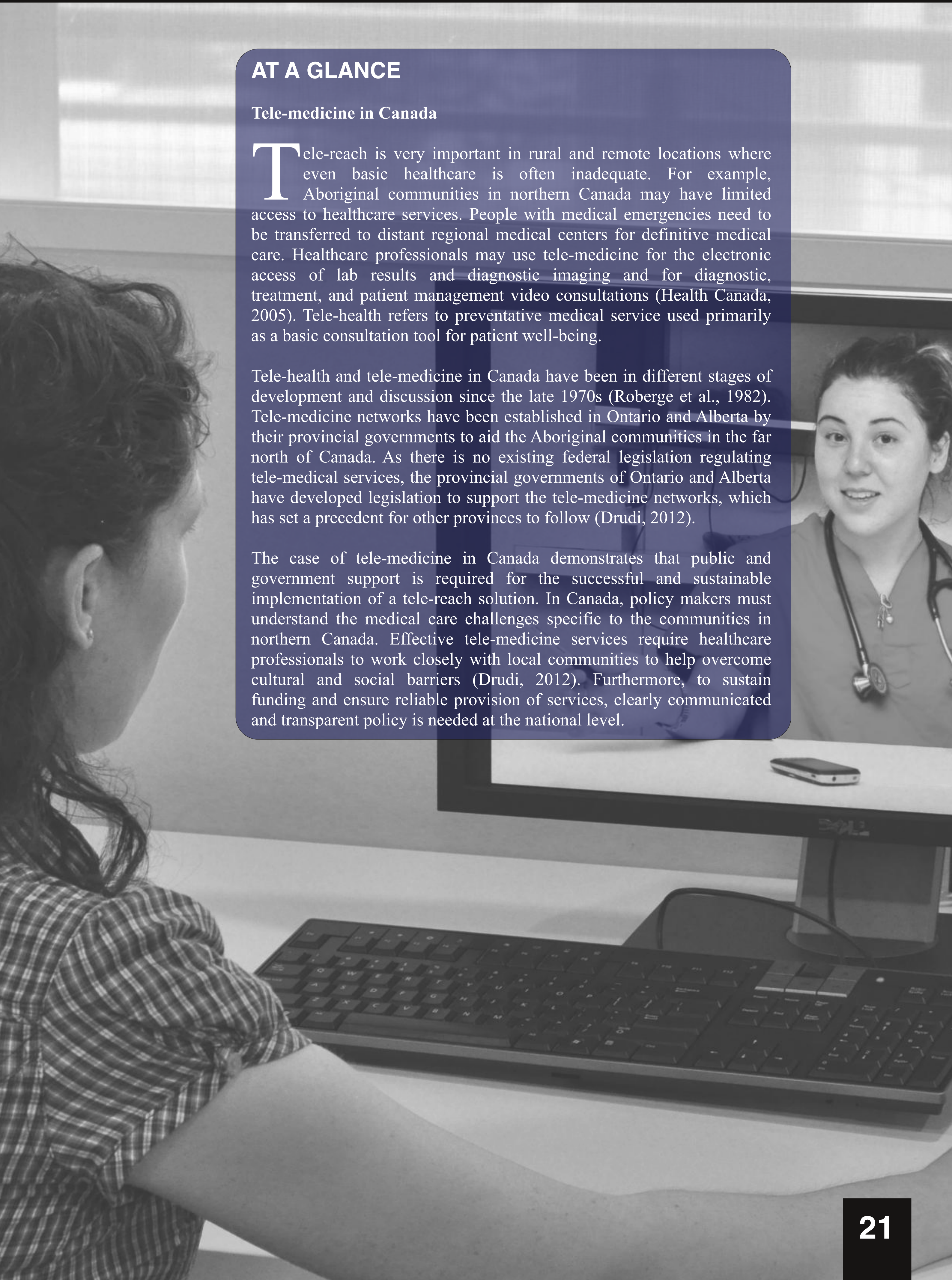
Data sharing between government departments is essential to avoid duplication of effort, to standardize information storage, and to provide a common platform for easy sharing of information. On a global scale, the Group on Earth Observations (GEO) and Global Earth Observation System of Systems (GEOSS) organize Earth observing information to make data easily accessible and to maximize its utility to all nations. The International Telecommunication Union (ITU), Internet Society, and Internet Engineering Task Force (IETF) play a coordinating role in information and telecommunications technologies. By adopting an information-sharing model within a nation, governments can maximize their data efficiency and allow the best return on resources invested in tele-reach programs. By cooperating with these organizations, countries of the Global South can benefit from data sharing.

Legal and Policy

Tele-reach program development may require bilateral and multilateral cooperation, as well as the creation of national laws and policies. Furthermore, these legal requirements must be formulated prior to negotiations for regional cooperation. Next, development of a Charter to address the issues raised could provide a blueprint for further cooperation within the Global South. Important policy development considerations are outlined in Figure 16. For example, the International Charter - Space and Major Disasters, provides a coordinating mechanism for countries and other entities to collaborate on disaster management (International Charter – Space and Major Disasters, 2000).

Figure 16: Policy Development Considerations





AT A GLANCE

Tele-medicine in Canada

Tele-reach is very important in rural and remote locations where even basic healthcare is often inadequate. For example, Aboriginal communities in northern Canada may have limited access to healthcare services. People with medical emergencies need to be transferred to distant regional medical centers for definitive medical care. Healthcare professionals may use tele-medicine for the electronic access of lab results and diagnostic imaging and for diagnostic, treatment, and patient management video consultations (Health Canada, 2005). Tele-health refers to preventative medical service used primarily as a basic consultation tool for patient well-being.

Tele-health and tele-medicine in Canada have been in different stages of development and discussion since the late 1970s (Roberge et al., 1982). Tele-medicine networks have been established in Ontario and Alberta by their provincial governments to aid the Aboriginal communities in the far north of Canada. As there is no existing federal legislation regulating tele-medical services, the provincial governments of Ontario and Alberta have developed legislation to support the tele-medicine networks, which has set a precedent for other provinces to follow (Drudi, 2012).

The case of tele-medicine in Canada demonstrates that public and government support is required for the successful and sustainable implementation of a tele-reach solution. In Canada, policy makers must understand the medical care challenges specific to the communities in northern Canada. Effective tele-medicine services require healthcare professionals to work closely with local communities to help overcome cultural and social barriers (Drudi, 2012). Furthermore, to sustain funding and ensure reliable provision of services, clearly communicated and transparent policy is needed at the national level.

Administration

The Brazilian Deforestation Case Study (p.23), demonstrated that interdepartmental cooperation was key to a continued successful partnership. Within government frameworks, there are a number of stakeholder departments to monitor social benefit, investment and return, as well as to coordinate infrastructure and delivery of services (see Figure 17). Parties involved also need to be prepared to reallocate resources to continue the success of any program, especially where intercultural needs exist. If the concept of tele-reach as a national resource is to become a reality, particularly for those in the Intermediate and Emerging Tiers, governments will be required to study the areas of greatest need and ensure an equitable division of tele-reach resources. Each stakeholder department needs access to demographic information to have a common understanding of unique cultural differences and to provide a tailored solution. Governments need to find a mechanism for creating commercial opportunities for local industry within the tele-reach area.

Figure 17: Primary Administration Stakeholders

Mercado and Ravichandra Rao (1992) found that in VRCs in India, only 20-25 percent of data was used, reporting that the content was not optimized or relevant to the local community. Understanding community demographics helps to ensure the success of future tele-reach programs.

Conclusions

- Interdepartmental communication, data-sharing, and cooperation enhance the results of collaborative projects and reduces duplication effort.
- A national space policy or direction improves management and use of state resources, reduces duplication of effort, provides direction to industry within a nation, and informs partners outside the nation.

AT A GLANCE

Deforestation Monitoring Program in Brazil

Brazil has made significant advances in monitoring the level of deforestation in the Amazon Rainforest (Nature Blog, 2012). The Brazilian National Institute for Space Research (INPE) has been monitoring Amazonian deforestation since 1988, through the Brazilian Amazonian Forest Monitoring by Satellite (PRODES) and the Real Time Deforestation Detection System (DETER) programs (Dupas et al., 2008). PRODES uses data from Landsat satellites and China-Brazil Earth Resources Satellites (CBERS), while DETER uses data from Moderate Resolution Imaging Spectroradiometer (MODIS) sensors on-board the National Aeronautics and Space Administration (NASA) Aqua and Terra satellites. The data generated is then used by Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and the Brazilian Federal Police to detect areas of deforestation for operational and law enforcement purposes. The DETER and PRODES programs are a step towards Brazil reaching its international commitments such as the Copenhagen accord, which aims to reduce deforestation by 80% by 2020 (Nature Blog, 2011). These programs have also been crucial in negotiations towards future climate change agreements (Kintisch, 2007).

In the 1990s, Brazil had probably the world's highest deforestation rate, but it started curbing deforestation in 2004, aiming to become a CO_2 sink by 2020 (Barrionuevo 2012). Deforestation monitoring policies in accordance with DETER and PRODES has increased the level of prosecution from illegal deforestation activities. These policies also helped to optimize land use for cattle growing and farming, as well as helping forest conservation while maintaining Brazil's lead in world food production (The Economist, 2010). Still to be solved are the clashes between environmentalists and agribusiness, who have been fighting for an adequate revision of the 47-year old Forest Code (Nature Blog, 2012).

This paper has discussed the need for tele-reach collaboration in the Global South, the diverse range of factors that influence it, and a web-based resource for facilitating that collaboration. The team proposed that *telereach.org* will lay the foundation for TeOSS, which would institutionalize tele-reach collaboration in the Global South. Within the TeOSS framework, full international collaboration on tele-reach in the Global South would be achieved by 2020.

Figure 19: Sustainable tele-reach Solution Development

This section puts forth a process for developing and implementing TeOSS by 2020. The team recommends a reallocation of resources and priorities to efficiently and effectively benefit the specific needs of the Global South. The survey of issues presented by this paper shows that sustainable tele-reach solutions are best achieved when social needs drive policy to enable the development of the business model and infrastructure (Figure 19).

Figure 20: Collaboration framework to 2020

1. National Space Policy and Direction 2. Prioritize Tele-reach Applications 3. From Pilot Program to Sustainable Tele-reach Solution	1. Regional Steering Group 2. Regional Collaboration Entity 3. Overcome Challenges 4. Priorities in Collaboration 5. Sustainability	1. International Body for the Global South 2. Charter, Membership, Funding 3. Standardization of Processes 4. Evolving Framework 5. Integration with the Global North
POLICY, PRIORITIES AND POSTURING	REGIONAL COLLABORATION	INTERNATIONAL COLLABORATION
2012	**2015**	**2020**

In other successful international initiatives such as GEOSS, national policy has been adapted to enable international collaboration on shared challenges. In these cases, policy was driven by a common need recognized by various countries and groups. The ability to respond to that need was understood and then scaled up to an international level. The team recommends a similar process in the Global South for our proposed TeOSS framework. This process will not be without a number of hurdles: geographical distance, cultural and linguistic barriers, issues of technology transfer, and open data policy (Camara, 2012). Nevertheless, TeOSS can significantly and positively impact the Global South in many need areas, and is a worthwhile pursuit. Figure 20 represents the process for forming and institutionalizing TeOSS over the next eight years. These activities can also occur in parallel, with the goal of full tele-reach collaboration in the Global South by 2020.

TeOSS will act as a coordinating mechanism for reducing effort duplication and maximizing the efficacy of tele-reach in the Global South. The case studies presented in this paper are a sample of current and past tele-reach programs, all of which can inform the activities of TeOSS and enable it to incorporate previous experiences and lessons learned. Additional resources to serve this purpose will be located on the *telereach.org*. The last case study, the Millennium Village in Sri Lanka, captures all the elements necessary for sustainably implementing a tele-reach solution that has been discussed in this paper. It could be used within the TeOSS framework as a model for efficient, effective, and sustainable tele-reach applications.

AT A GLANCE

Millennium Village Case Study

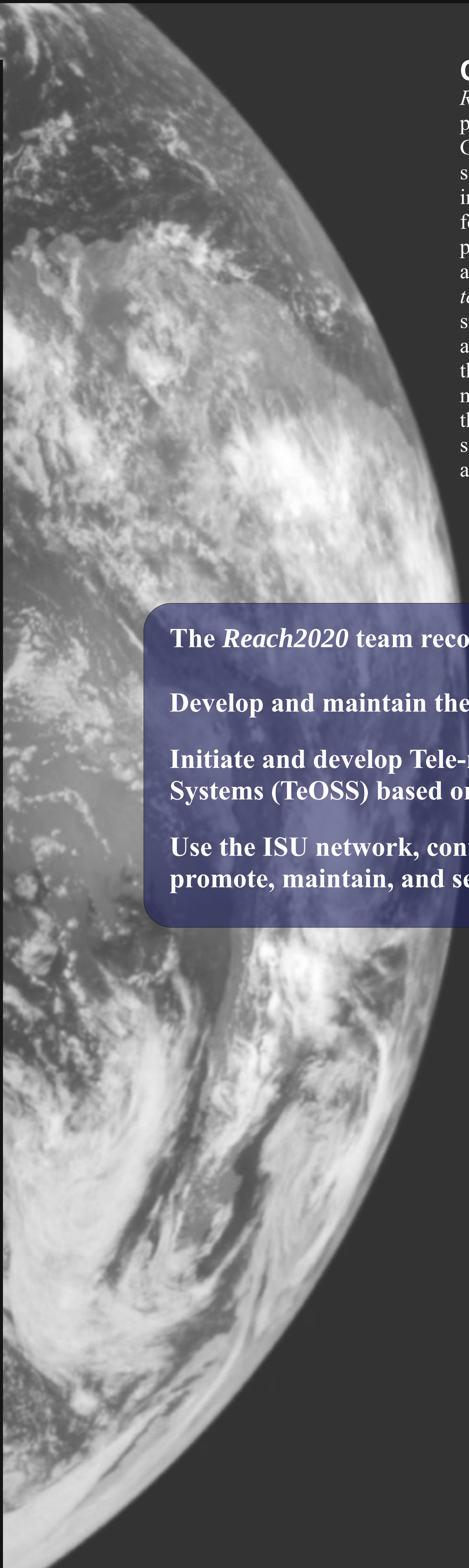
Many rural areas lack basic facilities, including communication, health, resource management, and power. The concept of the Millennium Villages was developed by Dr. Joe Pelton with the Arthur C. Clarke Foundation (Clarke Foundation) in collaboration with Dr. Richard Freling of the Solar Electric Light Fund (SELF). This idea provides an innovative way for remote villages to communicate with each other and with the outside world. Training is provided to villagers to use ICT and tele-reach solutions. (Pelton, 2012 ; Arthur C. Clarke Foundation, 2008)

The Millennium Village concept has been implemented in Moratuwa, Sri Lanka as a project with current and future funding support being jointly sought through the Japan International Cooperation Agency (JICA) and SELF (SELF, 2011). A combination of multiple ICT systems is necessary to provide an economically sustainable model to promote development in these remote areas.

The concept involves two villages: one located on the coast and the other in a mountainous area. The Sri Lanka project can serve as a guide for accessing power needs, both solar and battery operated, in community areas for future Millennium Village concepts. The Millennium Village concept can be adopted within nations which are aiming to improve basic facilities and support economic progress.

A series of models and pathways to implementing tele-reach solutions in the Global South are discussed in this paper. A national space policy is an essential step forward. Political will can either impede or enhance collaborative activities by providing internal guidance, and informing international cooperation (Williamson, 2012). By collaborating and cooperating on tele-reach, the Global South can benefit from existing programs and realize its developmental aspirations.

In the Global South, proven space technology will enable rapid development. Nevertheless, increasing dependence on space-based services raises the issue of space as a finite and vulnerable resource. The sustainability of the space environment is vital to the success of tele-reach. Issues of space sustainability that must be addressed include: space debris, space traffic management, monitoring of space weather and near-Earth objects, extending spacecraft operational life, and space situational awareness.



Conclusion

Reach2020 has identified the first step and a process for collaboration on tele-reach in the Global South. Identifying needs, defining policy, selecting a business model, and providing infrastructure are required to establish a way forward at a national level. Within each Tier, the path may differ, but the elements required are always the same. The tele-reach portal, *telereach.org*, provides a mechanism for stakeholders to collaborate, share, discuss, learn, and develop better ways of applying tele-reach to the social and economic needs of the region. The next step towards international collaboration is the development of TeOSS, which would be similar to the GEOSS model, to make *Reach2020* a global reality.

The *Reach2020* team recommends:

Develop and maintain the web-based portal *telereach.org*.

Initiate and develop Tele-reach Operational System of Systems (TeOSS) based on the GEOSS model by 2015.

Use the ISU network, conferences, and workshops to promote, maintain, and seek contributions to *telereach.org*.

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Acronyms

3GPP	Third Generation Partnership Project
4G	Fourth Generation Wireless
A	
AIDS	Acquired Immune Deficiency Syndrome
C	
CAPART	Council for Advancement of People's Action and Rural Technology
CBERS	China-Brazil Earth Resources Satellites
CCID	China Center for Information Industry Development
D	
DETER	Real Time Deforestation Detection System
DRM	Disaster Risk Management
E	
EPA	Environmental Protection Agency
G	
GIS	Geographic Information System
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
H	
HSBC	Hong Kong and Shanghai Banking Corporation
I	
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
ICT	Information and Communication Technology
IETF	Internet Engineering Task Force
IGNOU	Indira Gandhi International Open University
INPE	National Institute for Space Research
INR	Indian Rupees
IP	Internet Protocol
IPoS	Internet Protocol over Satellite
ISRO	Indian Space Research Organization

ISU	International Space University
ITU	International Telecommunications Union
J	
JICA	Japan International Cooperation Agency
L	
LTE	Long Term Evolution
M	
MDG	Millennium Development Goals
MIIT	Ministry of Industry and Information Technology
MODIS	Moderate Resolution Imaging Spectroradiometer
MSSRF	Swaminathan Research Foundation
N	
NASA	National Aeronautics and Space Administration
NGO	Non-governmental Organization
O	
O3b	O3b Networks Ltd. (Other 3 billion)
P	
PPP	Public Private Partnership
PRODES	Brazilian Amazonian Forest Monitoring by Satellite
R	
ROI	Return on Investment
S	
SELF	Solar Electric Light Fund
SHS-SP12	Southern Hemisphere Summer Space Program 2012
T	
TCP	Transmission Control Protocol
TOSS	tele-reach operation system of systems
U	
UN	United Nations
UNAID	Joint United Nation Programme for HIV/AIDS
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UN-SPIDER	United Nations Platform for Space Based Information for Disaster Management and Emergency Response
UniSA	University of South Australia
V	
VKC	Village Knowledge Centre
VRC	Village Resource Centre
VSAT	Very Small Aperture Terminal
W	
WHO	World Health Organisation

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