INFORMATION COMMUNICATION TECHNOLOGY, SATELLITE REMOTE SENSING, AND PEACE SUPPORT OPERATIONS

BY
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10 April 2008

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A Thesis submitted in partial fulfilment of the requirements for the United Nations Certificate of
Training in Peace Support Operations
ABSTRACT

Most conflicts witnessed in recent years bear the characteristics of civil war or insurgency and are often confined to the poorest regions of the world, already marked by inadequate infrastructure. In the conflict vicinity there is further breakdown of physical and societal fabric leading to amongst others, ruptured communication and road transport links. The Peace Support Operation (PSO) is expected to achieve its mandate within such constraints, support the myriad of relief agencies in its theatre of operations and cope with influences related to the high-tech driven and near real time coverage of its activities. In order to maintain situational dominance in this modern environment, there is need for specialized tools. Despite rapid developments in computer technology, remote sensors and communications since the end of the cold war, the potential of Information Communication Technology (ICT) and Satellite Remote Sensing (SRS) in PSO remains underutilized. This paper investigates the possible applications of ICT and SRS in enhancing modern day PSO with a view to suggesting how the United Nations can apply the technologies at all levels of UN PSO from UNHQ to operations in the field.
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1. INTRODUCTION

The Charter of the United Nations (UN) was drafted at the San Francisco Conference in 1945 and its first article states that a main purpose of the UN is “…to maintain international peace and security”. The Charter also provided guidelines on how the various organs of the UN were to achieve this responsibility. Specifically, Chapter VI of the UN Charter provides for pacific settlement of disputes, Chapter VII is essentially coercive and Chapter VIII deals with involvement of regional agencies in maintenance of peace and security. Although the terms peace keeping and Peace Support Operations (PSO) were not directly mentioned in the UN Charter, they have evolved as a pragmatic response to a variety of international conflicts that the world has witnessed in recent years. The achievement of PSO have proved invaluable to ensuring that the UN achieves its set aims and not drift into the same lapses that caused the collapse of its predecessor the League of Nations.\textsuperscript{[1-1]}

Soon after the Charter was ratified on October 24 1945 the world’s first large scale computer, \textit{the Electronic Numerical Integrator and Computer} (ENIAC) was introduced on February 14, 1946. The relationship between both events may still seem unclear today but the impact of both creations can not be over emphasized. The UN is currently the most prominent intervention mechanism and PSO its foremost strategy for managing and resolving post-Cold war conflicts in the global community.\textsuperscript{[1-2]} This same global community has come to be defined by high speed telecommunications, satellites and computer networks driven by rapid
advances in Information and Communication Technology (ICT). This ease of information transfer has introduced a whole new dimension to global conflicts which are now smaller and intra-state albeit strengthened by the collapse of super power rivalry in the early 90’s.

As the threats to international security are increasingly complex, the response of the UN and PSO’s has had to become more elaborate and functionally vast. The new demands placed on PSO require a multifaceted approach in terms of functions such as conflict prevention, humanitarian assistance, human rights monitoring, electoral monitoring, demobilization and rehabilitation, peace building and post-conflict reconstruction. There are also new developments on mission composition such as use of civilian peacekeepers, humanitarian personnel, and inter-governmental, governmental and non-governmental actors.

The new kinds of conflict and the diverse nature of contemporary operations call for greater use of ICT and Satellite Remote Sensing (SRS) technology. Fortunately, since the end of the Cold War there has been a correspondingly rapid development in ICT and SRS. However, their potential applications in PSO remains largely untapped.\(^{[1-3]}\) It is not expected that the UN would acquire its own sophisticated satellite or radar system within the near future, nevertheless, it is important that the UN take a leadership role in developing strategy and policy for IT applications in PSO.\(^{[1-4]}\) The world and UN is aware of these realities and on 7 September 2000, the UN Security Council (UNSC) voted unanimously to overhaul its peacekeeping operations.
The UNSC was in agreement that there was urgent need for a more professional and high-tech UN force that could work harder at conflict resolution. In agreement the then US Secretary of State Madeleine Albright noted that “old models of peacekeeping don’t always meet current challenges. Peace operations today often require skills that are neither strictly military nor strictly police but rather a combination of the two. The international community needs to identify and train units that are able to control crowds, deter vigilante actions, prevent looting and disarm civilian agitators while at the same time winning the trust of the communities in which they are deployed.”[1-5]

The decision to overhaul the UN response to PSO led to the Brahimi report which highlighted the need for a new peacekeeping strategy including greater use of ICT while further recommending that an executive information and strategic analysis secretariat (EISAS) be formed at UN HQ level. The EISAS has not been implemented. However when it is it will be expected to be composed of information system specialists, military analysts and criminal network experts.[1-6] This is particularly pertinent if the UN intends to retain relevance in the PSO of the future.

The General Assembly has also not been left out in initiating ICT reform, as it passed resolution 57/295 for the development of a comprehensive ICT strategy for the UN under the leading of the UN system Chief Executives Board for Coordination (CEB). There have been several meetings under the purview of the CEB and current efforts have been on developing knowledge sharing and knowledge management amongst UN
agencies and organs to aid implementation of an ICT strategic framework for the UN.\textsuperscript{[1-7]}

Other continuing reform efforts to integrate ICT into the wider UN System and member states have come under different recent fora such as the 2005 “Millennium plus–5” summit, itself preceded by the UNSG report “In Larger Freedom” and the direction of the 2007 “High Level Panel”. Although targeted at broader applications of development, security and human rights they are germane to the thesis. The report “In Larger Freedom” notes that the onus is on the governments of UN member states to increase indigenous capacity for ICT by establishing relevant infrastructure and the Millennium plus–5 summit built on this by providing financing in the form of a Digital Solidarity Fund to bridge the digital divide.\textsuperscript{[1-8]}

All available indices suggest that Africa is falling behind in the achievement of the millennium goals particularly as it affects security, science and technology.\textsuperscript{[1-9]} Progress is being made however, with the large number of African troops involved in PSO and the increased ICT and satellite activity led by the launch of earth observation satellites by Algeria and Nigeria into low earth orbit in 2002 and 2003 coupled with the launch of a Nigerian communications satellite into geostationary orbit in 2007. This thesis will examine how the use of SRS and ICT provides opportunities for enhancing the achievement of modern PSO. It will highlight areas where the use of such technology will prove effective in current and future mission accomplishment.
1.1 Motivation

The relationship between ICT and SRS in enhancing modern day PSO is surprisingly undeveloped. Most conflicts witnessed in recent years are internal and confined to the poorest regions of the world marked by inadequate infrastructure and being at the sorry end of the digital divide. The UN often has to plan the PSO amidst shrinking resources but increasing expectations on one hand while the PSO mission itself, has to implement its mandate within the purview of fractured communication links and ruptured road transport networks. Additionally despite such constraints the UN has yet to fully integrate advanced technologies in a systemic manner.

There is a deficit in the technological capability of some PSO missions because the level of technology employed depends largely on the contributing nations and the individual field commanders.\textsuperscript{[1-10]} A large number of these conflicts and PSO missions are in Africa so it is not surprising that a lot of the troop contributing countries and police contributing countries (TCC/PCC) are African. The current list of TCC and PCC as at January 2008 are at Annex A. This list will be partially increased by the planned 26,000 strong UN/AU hybrid force in Darfur (UNAMID), which itself is a case in point because the mission is still held back by logistical and other difficulties.\textsuperscript{[1-11]}

In a slight twist there has also been a corresponding increase in ICT and satellite activities across Africa driven by countries such as Nigeria, South Africa and Algeria.\textsuperscript{[1-12]} This suggests greater need for African
information system specialists on one hand and increased UN determination to exploit the use of ICT and Remote Sensing in PSO.

1.2 Objective

This thesis will examine ways in which the UN peacekeeping can benefit from the rapid advances in technology which has also led to the availability of effective but low-cost communication and satellite sensor solutions. There appears to be little relevant research material on the subject and this thesis will also add to the available research material.

1.3 Scope

This thesis shall cover the following:

(1) Chapter One: Introduction
(2) Chapter Two: Concepts and Background
(2) Chapter Three: ICT and PSO
(d) Chapter Four: SRS and PSO
(e) Chapter Five: Other Matters including Case Scenarios
(f) Chapter Six: Suggestions and Conclusion

1.4 Methodology

This is a proactive study encouraged by the increased satellite and ICT activity in Africa as well as recent restructuring of UN peacekeeping.
Since it is still early days there is not much documentation available consequently the research was mainly online. The main thrust was aimed at studying modern trends and requirements in PSO with a view to understanding the applicability of ICT and SRS technology to enhance present efforts. Such online resources included journals, past newspapers and articles. Until recently satellite payload technology was the exclusive preserve of a fortunate few hence the difficulty in obtaining sufficient technical information.

The United Nations Institute of Training and Research Programme of Online Correspondence Instruction (UNITAR POCI) course texts were a valuable source of information as well as the classroom course on Global Terrorism & Peacekeeping and International Conflict Resolution: Security Dilemma dealing with fear, uncertainty and interpretation. In addition, there have been email discussions with current peacekeepers in UN missions in Africa with a view to sampling the realities on ground. This is called ground truth in satellite calibration. Experience gathered from the Nigerian Navy (NN) and small satellite environment will also be relied upon to provide current analysis and factual solutions.
2. CONCEPTS AND BACKGROUND

2.1 PSO Concepts and Definitions

2.1.1 PSO Concept

As a concept Peace Support Operations (PSO) evokes different meanings depending on the user. As a term PSO was introduced by the United Kingdom (UK) to cover peace-keeping and peace enforcement operations.\[^{2-1}\] The North Atlantic Treaty Organization (NATO) doctrine uses the concept within the context of its non-Article 5 Crisis Response Operations (CRO) which are operations designed to face the challenges posed by intricate crises in an uncertain strategic environment.\[^{2-2}\] Due to the evolving nature of the tactical environment it is expected that PSO will be conducted impartially with a mandate authorized by an internationally recognized organization such as the UN or African Union (AU) whose mandate it supports.

Wilkinson and Rinardo (1996) further note that “Support” suggests that military activities will be provided in support of political goals. This is because success in a PSO is not defined by military concepts of victory and defeat but the achievement of a long-term political settlement or condition specified by the mandating international organization. In order to fully achieve the mandate there is need to respond to such crises with both military elements and civilian “forces” such as diplomatic, rule of law and humanitarian agencies.
Essentially, the military role is to create the necessary stable environment for the other civilian institutions to work. The PSO concept of operations (CONOPS) includes activities before, during and after conflict and therefore will embrace all types of activity to prevent conflict, intervene in a conflict and also regenerate and sustain a secure environment following conflict. Depending on the nature of the specific PSO mandate and the desired end-state, such activities may include Peace Enforcement and Peacekeeping as well as Conflict Prevention, Peacemaking, Peace Building and Humanitarian Relief.

The United States (US) and some other nations prefer to use Peace Operations (PO) as the generic term for missions mandated by the United Nations. The US presidential Decision Directive 25 uses the term PO and not PSO to cover the entire spectrum of activities from traditional peacekeeping to peace enforcement. This is because US doctrine naturally embraces the notion of military subordination to political objectives and “Support” is therefore seen as a separate way to further multinational efforts such as logistical, financial or humanitarian. This has been the case in the UN mission in Liberia (UNMIL) when the US in partnership with the Nigerian Air Force (NAF) provided emergency airlift capability to increase the number of troops on the ground.

However, regardless of definition and whether led by the UN or another entity, the overall aim of a PSO is to contain and de-escalate conflict, while concurrently working in partnership with international agencies and organizations to address the root causes of such conflict. It therefore addresses a spectrum of activities including five principal activities:
conflict prevention, peacemaking, peacekeeping, peace-building and peace enforcement.\textsuperscript{[2–3]} This is the NATO interpretation of the concept and that is how the term will be used in this paper. The interrelationship between the five activities is shown in figure 2–1 below.

\textbf{Figure 2–1} Five Fingers of Peace Support Operations\textsuperscript{[2–4]}

\textbf{2.1.2 PSO Definition}

Figure 2–1 Illustrates PSO as a term broadly encompassing conflict prevention, peacemaking, peace-keeping, peace enforcement and peace building. It is important to attempt to define the individual elements.
Conflict prevention includes efforts to keep *intra-state or inter-state tensions and disputes* from escalating into deadly violence. It could involve confidence building and early warning depending on the requirements of the information gathered. Gathering of this intelligence may be either informal or formal fact-finding and may result in preventive deployment, creation of demilitarized zones or other measures to forestall conflict.

Peacemaking is directed to resolving conflicts in progress via means of UN good offices or diplomatically via envoys, governments or prominent personalities without use of military or police elements. The Capstone Doctrine document (2008) notes that it “… involves diplomatic action to bring hostile parties to a negotiated agreement through such peaceful means as those set out in Chapter VI of the UN Charter.”

There are varying definitions for peace-keeping and peace enforcement. However, there is broad international agreement in the approach to what a UN operation requires and on the significant differences between both operations. The major difference is in regards to consent and the degree required of either to make the tactical environment secure. The United States, Britain, France and Nigeria feature this principle of consent as the critical distinguishing criterion between the conduct of Peace-keeping and Peace enforcement.

Peace-keeping operations are carried out with the consent of belligerent parties in support of efforts to achieve or maintain peace in areas of potential or actual conflict. The Capstone Doctrine Document
links the concept with peace making by defining it as, “a technique designed to preserve the peace, however fragile, where fighting has been halted and to assist in implementing agreements achieved by the peacemakers”. \[2-5\]

**Peace enforcement** operations are carried out to restore peace between belligerent parties who do not all consent to intervention and who may be engaged in combat activities.\[2-6\] it involves applying military force amongst other coercive measures with the authorization of the Security Council in situations where such actions may restore a breach of international peace and security to normalcy.

**Peace building** typically comes after the previous two and simply refers to efforts to make a secured environment self-sustaining. It is now being given more prominence due to the fact that *roughly half of all countries that emerge from war lapses back into violence within five years* while the UN does not have any institutional machinery to help countries in the transition from war to lasting peace.\[2-7\] Since it attempts to address the root causes of violent conflict as well as address the fundamental flaws in a conflict prone society it is often a complex and long term process that is becoming increasingly prevalent in modern day PSO.

*Conflict prevention, peacemaking, peacekeeping and peace enforcement rarely occur in a linear or sequential way.*\[2-8\] Therefore UN PSO may be mandated as an inter position force to forestall conflict and other times have to support the implementation of a cease-fire or a peace agreement in the same breath. They may also be required to play an active role in
peace making efforts or the early stages of peace building. While an even more robust mandate may require actions to actively enforce the peace and keep the peace when enforced.

Consequently for the purpose of this thesis PSO is defined to refer to actions carried out within the purview of all 5 activities. These actions may include: observation and monitoring, supervision of Truces and Cease–fires, Demobilization operations, conflict prevention and Military Assistance. Also Humanitarian Relief and Convoy Protection, Establishment and Supervision of Protected Areas, Mine Awareness and Mine Clearance Operations, Sanctions Monitoring and Guarantee or Denial of Movement. Lastly, Counter Drug Operations, Non–combatant Evacuation operations, Counter Insurgency, Counter Terrorist and Combat Search and Rescue. It is with the definitions and activities in mind that we attempt to contextualize the evolution of PSO to its present–day expectations and the necessity for technological change to meet those requirements.

2.2 Evolution of PSO

Personnel in PSO have carried out diverse tasks and supported different types of international mandates with varying levels of success. The UNITAR POCI course book on *Principles for the Conduct of Peace Support Operations* suggests that there are two categories of PSO namely the traditional and second generation peacekeeping. However in terms of functionality Dr Walter Dorn, Professor of Strategic and Security Studies
of the Royal Military College of Canada notes that there have been roughly four generations of operations.\textsuperscript{[2–9]}

Traditional peacekeeping itself can be divided into Observer Missions such as the commissions sent to Greece in 1946 and Interposition Missions first used in 1956. As the lone cold war gave way to multiple hotspots there was a dramatic increase in PSO functions and these multi-mandate missions could be described as the third generation. In the new millennium some missions have had to govern territories during a transitional period. Recent events suggest that this evolution has continued unabated as the novel but hybrid United Nations and African Union force in Darfur (UNAMID) is desperately trying to forge a direction considering the lack of precedence.\textsuperscript{[2–10]} Each new generation of PSO is precipitated by familiar fears but to meet the new requirements ushers in new lessons.

The Observer Missions main purpose was to observe the deployments and activities of the armed forces of two or more conflicting countries. They were usually based on cease fire agreements that were typically mediated by the UN and negotiated by the states themselves. A good example of this is the United Nations Truce Supervision Organisation (UNTSO) deployed in the Middle East in 1948 (till date). The observers on ground were typically unarmed since they had the support of both parties.

Sometimes the mandate of such operations also included ‘supervision’ or ‘observe and report’ roles. When necessary they were \textit{expected to quell violence using arms such as advice, aid and mediation}.\textsuperscript{[2–11]} Fortunately,
such weapons still remain the basic tool of trade because regardless of
the generation or type of PSO the UN tries to deescalate fighting through
negotiation, mediation and the exercise of its good offices. Unfortunately
the UN can only succeed to the extent the parties permit.

In second generation operations first exemplified by the 1956 Sinai
mission, the UN force was mandated to separate the Egyptian army from
the invading forces of Israel, France and the UK. This operation
successfully ended the Suez crisis and is a prime example of Interposition
Operations in which the UN PSO force is interposed between conflicting
armed forces. Unlike the first generation observer mission the PSO
personnel are armed and deployed in preformed units such as battalions.

They separate conflicting sides, reducing the number and frequency of
military contacts thereby permitting a more effective monitoring of
troubled zones between both parties. It is significant to note that the PSO
must “anticipate” any forward movements of military forces from agreed
positions and possibly place themselves physically in the way of such
advances. This was attempted by the use of ground sensors that detected
breaches in the limiting lines. The use of sensors in this manner was
possibly the first time remote sensors technology was used to directly aid
a UN PSO.

However, the operational principles guiding this (and subsequent)
generations were set out by UN Secretary General (UNSG) Dag
Hammarskjold in his 1956 report to the General Assembly proposing the
United Nations Emergency Force (UNEF).\textsuperscript{[2-12]} The force was to be under
the command of the UNSG, recruited from UN member states other than the permanent members (possibly to avoid the bipolar influences of the cold war era), impartial, sponsored by the UN and non-combatant.

In the case of UNEF Israeli Premier Ben Gurion’s initially refused to allow foreign troops on Israel soil, therefore UNSG Hammarskjold negotiated an agreement with the host state that became the model for future Status of Force Agreements (SOFA).[2-13] Almost all first and second generation operations required and received invitations from the host state and had high levels of consent.

This implies that such PSO missions are not tenable when the parties are determined to continue fighting and could be withdrawn on request of the host state as was the case in 1967 when Egypt asked for the withdrawal of UNEF. Naturally there have been exceptions to this but to do so the concerned mission had to have a correspondingly robust mandate. The United Nations Operation in Somalia (UNOSOM) had a strong mandate as well as the Iraq–Kuwait Observation Mission (UNIKOM) which occupied territory in both Iraq and Kuwait. They could not be withdrawn without security council authorization.[2-14][2-15]

The Next generation of UN peacekeeping was fostered by end of the cold war and the harsh realities that resulted. The UN became increasingly involved in internal conflicts and tried to bring peace between warring factions as well as assist in the difficult task of nation building. This ushered in the era of ‘multidimensional’ peacekeeping and the PSO mission demonstrated greater diversity in roles and function. The PSO tasks could
run the gamut from traditional observation of armed forces to the delivery of human aid, from human rights promotion to the supervision of elections. Consequently a greater variety of human and material resources was required and the mission was not just military with occasional civilian responsibilities but a mixture of both with a myriad of responsibilities. In effect the UN PSO now had to be involved in political, humanitarian, police, judicial, electoral and human rights to name a few.

Significantly the UN had to keep track of not only military elements but also attempt to reform the security sector as a whole since unreformed institutions posed a renewed threat to the peace process.\textsuperscript{[2-16]} Having to deal with insurgency, genocide situations or civil war meant the training of new border guards, judges and prosecutors. In some missions activities sometimes expanded to supervision of certain departments of government such as defence and foreign affairs, fighting crime, cross border smuggling and enforcing UN sanctions. This was not just the experience of the UN, as regional organizations like the Economic Community of West African States Monitoring Group (ECOMOG) used Nigerian officers as Chief’s of staff in Liberia, Gambia and Sierra Leone.\textsuperscript{[2-17]}

Fortunately on the world stage and unlike in cold war times, the major powers including the permanent UNSC members actively participated in multidimensional PSO. On a historical note a fore runner to such 3rd generation operations occurred from July 1960 to Jun 1964 in the Congo (this was called the UN operation in the Congo–ONUC). However since 1989 when the pioneering operation in Namibia was deployed there have been over 22 multidimensional PSO.
The fourth generation PSO missions were created for the purpose of Transitional Administration. These actually carry out the full functions of a government. Main examples are the UN missions in Kosovo (UNMIK) and East Timor (UNTAET). Kosovo is still under UN administration though East Timor became self governing in 2002.\textsuperscript{[2–18]} It is important to understand that the requirement of modern day peace keeping operations has evolved to necessitate a whole new approach to peacekeeping. Consequently there is a need to evolve new methods and employ new technology if the UN intends to remain relevant as the major conflict resolution body for now and the future. No organization is as much aware of this as the UN itself.

2.3 Change on Several Fronts

Due to a string of lapses experienced by UN operations in Somalia, Rwanda and Srebrenica in the 1990’s, Western support for UN missions declined and NATO took on new peacekeeping missions in Bosnia, Kosovo and the Kabul region of Afghanistan. The reason for the dismal trend was more than just \textit{Africa Fatigue} as most writers suggest.\textsuperscript{[2–19]} Nor was it entirely due to the deaths of American soldiers in Somalia and Belgian peacekeepers in Rwanda. These and other events only proved the inability of the UN structure to contend with the post cold-war increase in trouble spots and mission requirements. The fact was that in NATO, the military structure was better defined with a larger number of deployed troops.

\textsuperscript{[2–18]} Kosovo with European Union Support unilaterally declared independence March 2008 and has been recognized by US and EU but not Russia, Serbia or the UN. Situation is still unfolding.
Additionally, the level of technological support was greater, and partner nations were generally better equipped and trained than in typical UN missions.\[2-20\]

In order to transform the UN to better meet current and future threats to world peace urgent action was required. On 7 March 2000, UNSG Kofi Annan convened a high-level Panel to *undertake a thorough review of the UN peace and security activities* in the hope of improving UN capacity to meet the emergent challenges.\[2-21\] This Panel on United Nations Peace Operations was headed by Mr Lakhdar Brahimi and included eminent persons from around the world with vast experience in the fields of peacekeeping, peace building, development and humanitarian assistance. The panel undertook highly critical analyses of UN PSO around the world as well as the operations in Rwanda, Somalia and Srebrenica and submitted its recommendations on 17 August 2000.

The “Brahimi report” as it has come to be known identified 20 priorities to which several recommendations were made. Almost all aspects of the recommendations could be enhanced by use of ICT and SRS by the UN and its organs such as the UN Head Quarters (UNHQ), Department of Peace-Keeping Operations (UN DPKO), Department of Political Affairs (DPA) and Office of the United Nations High commissioner for Human Rights (UNHCHR) to name a few.

The General Assembly has also not been left out in initiating ICT reform, as it passed resolution 57/295 for the development of a comprehensive ICT strategy for the UN under the leading of the UN system Chief
Executives Board for Coordination (CEB). There have been several meetings under the purview of the CEB and current efforts have been on developing knowledge sharing and knowledge management amongst UN agencies and organs to aid implementation of an ICT strategic framework for the UN.

Other continuing reform efforts to integrate ICT into the wider UN System and member states have come under different recent fora such as the 2005 “Millennium plus–5” summit, itself preceded by the UNSG report “In Larger Freedom” and the direction of the 2007 “High Level Panel”. Although targeted at broader applications of development, security and human rights they are germane to the thesis. The report “In Larger Freedom” notes that the onus is on the governments of UN member states to increase indigenous capacity for ICT by establishing relevant infrastructure and the Millennium plus–5 summit built on this by providing financing in the form of a Digital Solidarity Fund to bridge the digital divide.

The full report and progress of implementation may be found online.\[^{2-22}\] However for purposes of this thesis aspects of the report and its implementation will be reviewed in light of the applicability of ICT and SRS. It is therefore important to conceptualize ICT and SRS.
2.4 Information Communication: Definition and Concept

2.4.1 ICT Definition

The term *Information Communication Technology* broadly refers to the “study, design, development and implementation of computer-based information systems especially software applications and hardware”.\(^{[2-23]}\) It encompasses the *study* or *business* or *actual products of* technology that is used to handle or process information and aid communications. When referring to all the aspects of computing and technology ICT is also known as Information Technology (IT).

2.4.2 ICT Concept

The concepts, methods and applications involved in ICT constantly evolve making it difficult to have a universally accepted definition or structure.\(^{[2-24]}\) However the three words behind ICT namely: Information, Communication and Technology provide a great starting point. Any product such as personal computers, digital television, consumer electronics, personal digital assistants (PDA), email or robots that can store, retrieve, manipulate, transmit or receive information electronically in digital form is within the purview of the term.

Traditional Information aspect of ICT involves things that can be done on a computer while the recent range of digital communication information represents technologies that enable people and organizations to communicate and share information digitally. They both include standard
and specialist applications software. Typical standard commercial-off-the-shelf (COTS) applications used for basic tasks include word processing (Microsoft Word), data base (Oracle, Lotus, Microsoft SQL server) and graphics (Adobe Photoshop and Illustrator) software. Specialist COTS applications include Computer Aided Design (CAD), Geo-referenced databases (GeoServer) and Satellite Orbit visualization tool-kits (STK) that have specific uses in industry or aerospace and defence fields.

The Communication aspect of ICT deals with data transfer by electronic means achieved through networks of transmitting and receiving equipment, wires or satellite links. Some networks of particular importance to PSO will be local area network (LAN) for Mission HQ, wide area network (WAN) for inter-Mission and broadband global area network (BGAN) for DPKO to PSO mission use. The well known Internet is a vast WAN with immense applications to PSO.

2.4.3 UN System ICT Strategy Framework

The UN has come along way since the millennium declaration when member states affirmed the necessity to use ICTs as a strategic tool to enhance the impact of UN development programmes and technical cooperation activities. The UNSG was requested as the Chairman of the UN CEB to work with other aspects of the UN System and the ICT Task force to form a veritable ICT Network for the UN System. It is important to note the difference. The ICT Task force was set up by the Secretary General at the request of the ECOSOC to explore how to enhance the
impact of ICT on development (ICT4D). However, the ICT Network is more in-house and aimed at greater use of ICT to enhance the operations of the UN System itself.

Therefore the ICT Network is responsible for coordinating ICT reform within elements of the UN System and the goal has been to evolve ICT standards by leveraging on the ICT Task Force, international stakeholders and other in-house actors in a consultative bottom-up approach. The proposed ICT reform includes the creation of the post of a Chief Information Technology Officer to implement and define a comprehensive Information Strategy for the UN Secretariat, a continuous effort to align ICT priorities with Secretariat performance objectives and a feasibility study which could result in a fully integrated global system to be introduced by 2009.\textsuperscript{12–25}

As part of the feasibility study the ICT framework for the UN is at the preliminary stage but the ICT Network along with the International Communications Center (ICC) have outlined eight (08) priority aspects or business cases.\textsuperscript{12–26} They include:

- ICT Services and Sourcing Strategy
- ICT development Network
- Common Application Solutions
- Knowledge Sharing
- Electronic Payment (ERP) Systems
- ICT Governance and Best Practices
- Business Case Development and Costing
• UN ICT Training

These broad priority areas are based on a holistic approach to ICT application to the UN System (it has actually been suggested that the goals and objectives of the implementing ICT Network is uncertain while the TORs seem to be unclear.) The truth is that trying to fashion an all inclusive policy for the UN System with its large number of organizations with differing requirements and responsibilities will not be easy as new developments in the ICT sector occur daily while ICT solutions are typically configured to the particular needs of the relevant organization. However the outlined business cases chosen after an exhaustive trade-off process to represent broad range requirements is a start.

This thesis will however narrow the scope of ICT implementation to consider the requirements and possible applications to PSO from the UN Department of Peacekeeping Operations (DPKO) as the strategic level to the PSO field mission and field components as operational and tactical levels respectively.

2.5 Satellite Remote Sensing: Definition and Concept

Remote Sensing is defined as the “science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation.” Reading this thesis is a form of
remote sensing because the “data” our eyes acquire are impulses corresponding to the amount of light reflected from the dark and light areas on the page. The brain (mental computer) analyses and interprets the dark areas on the page as collection of letters forming words.

SRS is the use of satellite technology to obtain the remote sensing data. Satellite technology is vast and encompasses several different fields such as guidance, navigation and control, remote sensing, communications, satellite meteorology, geographic information systems (GIS) and global position system (GPS) with more disciplines and applications emerging each day. The application of the satellite depends on the payload (sensor) borne onboard the satellite.

2.5.1 SRS Sensors

There are several different types of sensors from which we derive satellite data such as optical, radar and radio. The sensor collects data that may be analyzed to obtain information about the objects, areas or phenomena being investigated. The collected data can be of many forms such as variations in force distributions, acoustic wave distributions, or electromagnetic energy. There is a relationship between the type of data collected, the remote sensor used and the atmospheric window available, the effects of which hinder or enhance optimum observation.

Earth observation (EO) sensors receive electromagnetic emissions in various spectral bands which show what objects are visible, such as clouds, hills, lakes and other phenomena. GPS sensors transmit and
receive signals corresponding to the earth position of the interacting objects reflection while communication sensors receive data transmitted from an earth object to the space based sensor then relay the data to another object on the earth. Sensors can also detect an object’s temperature and composition, wind speed and direction, and environmental conditions such as erosion, fires and pollution.

2.5.2 SRS Process
The two processes involved in remote sensing are data acquisition and data analysis. Sensors first record the variations in the way the earth surface features reflect and emit electromagnetic energy then the data is examined depending on whether the received data is pictorial or digital. Thereafter viewing and interpretation devices are used to analyze pictorial data while a computer is used to analyze digital sensor data. Reference data about the resources being studied are used when available to assist in the data analysis.

The reference data which could be from historical archives or ground truth points, aids the analyst extract information about the detailed condition of the various resources over which the sensor data were collected. This information is typically compiled in the form of hard copy maps and tables or as computer files that can be merged with other layers of information in a GIS database.

Finally this information is presented to users who apply it to the decision making process. There are several options of software for spatial information management with environments designed to enable access to
geo-referenced databases, cartographic products and related metadata. Such software includes the GeoServer, MapServer, gvSIG, PostGIS and NASA World Wind for example. The technical details of SRS will be avoided in the thesis except in a case scenario where it will make explanation clearer.

2.5.3 Remote Sensing the UN

The UN is a vast, complex, decentralized and remotely distributed organization with regional and field offices all over the world. Aspects of the UN System already recognize that remote sensing (RS) and geographic information (GI) is crucial to enable timely and effective response to the complex and divergent issues faced daily. Some organizations within the UN System have more experience than others in GI applications. Consequently efforts are now being made to engender broad interagency collaboration aimed at leveraging the successes already recorded by several of its organizations in terms of collecting, analyzing and applying remote sensing data with a view to sharing those benefits.[2-29]

SRS is not addressed separately by any UN mechanism. However RS is within the purview of the geospatial issues addressed by the Cartography and Geography Information Science meetings which were first organised by the Cartographic Section of the Library and Information Resources Division of the Department of Public Information (DPI) in 1996 and led to the formation of the UN Geographic Information Working Group (UNGIWG). The UNGIWG has a task group (TG) that looks into RS issues.
As of the 7th plenary session held in Santiago, Chile in 2006 there where five standing TGs namely:

- Core Geo–Database (TG1)
- Remote Sensing (TG2)
- Interoperable Services (TG3)
- GIS Map Production Guidelines (TG4)
- Global Navigation Satellite Systems (TG5)

The series of UNGIWG meetings have grown to receive the full support of NGOs, industry and many UN departments, specialized agencies and programmes particularly those that have cause to use RS data. The Geographic Information Support Team (GIST) and Geo–Cells or working groups within the World Health Organization (WHO), Food and Agriculture Organization (FAO), DPKO and Office for the Coordination of Humanitarian Affairs (OCHA) are just some of the existing groups that have used RS technology.

Despite current usage of RS data present challenges include: unexplored opportunities to work with National Mapping Agencies (NMAs), NGOs and the private sector; non–homogeneity of existing data–sets qualities and most importantly lack of co–ordination across UN HQ, Field and regional organizations as well as non–availability of documented procedures for collection and management of remote sensing information and metadata. These challenges are being addressed by the UNGIWG’s strategic Vision and Plan in the spirit that success will breed support, coordination will breed success and cooperation will breed sustainability.
2.5.4 UNGIWG Vision and Plan for Geographic Information

The UN Vision for GI recognizes that GI (which is a larger subset of RS) is vital to the UN’s IT policy as a means of improving knowledge and decision-making by extending the traditional roles of maps to support rapid integration, analysis and modeling of information critical to achieve improved operational readiness and responsiveness.\textsuperscript{12–31} The Vision also aims to actively support nationally and internationally recognized Spatial Data Infrastructure (SDI) programs. The essence of the vision is to harness information by location in a decentralized geospatial information framework that allows for rapid but secure dissemination of RS data.

The UN worked with the Open GIS Consortium (OGC) to develop the UN Strategic Plan for Geographic Information (UNSP) now known as UNSDI. The UNSDI was adopted in February 2007 after the 2005 agreement-in-principle at Addis Ababa and consideration of the draft at Santiago in 2006. It aims to accelerate the growth of a UN SDI necessary to achieve its vision for GI/RS and addresses: Policy/Organizations, GI, Standards, Technology and People/Resources as shown in figure 2.2 below.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2-2.png}
\caption{SDI for UNSP$^{12–32}$}
\end{figure}
The full details of the UNSP (aka UNSDI) are available online at http://www.uncosa.unvienna.org/pdf/iamos/2008/presentations/ois-ungiwg.pdf. This Thesis does not attempt to discuss the plan other than note that the implementation strategy infers that individual agencies will implement their SDI activities in compliance with UNSDI alone or with partners and multiple partners may come together to provide deliverables under the guidance of the UNSDI board.

Therefore the DPKO and its PSO field missions will be expected to direct its own use of SRS data based on its peculiar requirements whether alone or in concert with other partners or organizations. The requirements and methods of achieving this will be discussed later in the Thesis.
3. INFORMATION COMMUNICATION TECHNOLOGY AND PEACE SUPPORT OPERATIONS

3.1 ICT for Peace

The use of ICT at every level of warfare is well known and widely documented. It is a major enabler of command, control, communications, computers, information, surveillance and reconnaissance (C4ISR). Apart from C4ISR, other uses of ICT range from directing smart weapons by modern armed forces to use of satellite communications by rebel groups in remote areas and triggering of terrorists bombs via mobile phones.\(^{[3-1]}\)

On the other hand, the relevance of ICT to achieving the Millennium Development Goals (MDG) and the concept of ICT for Development (ICT4D) has been the subject of several efforts by actors and activities involved in the promotion of ICT-enabled development.\(^{[3-2]}\) The UN System has been massively supportive of ICT4D however little has been mentioned about its application to conflict-related scenarios. One possible reason adduced is that conflict areas are seemingly out of reach of typical development actors and their efforts.

Former UNSG Kofi Annan observed that, “Less well known than the role of ICTs in efforts to achieve the MDG is the contribution they make in our (UN) work to promote peace and help the victims of humanitarian emergencies”.\(^{[3-3]}\) The fact is that both the threat and experience of
conflict both hinder development and therefore has recently begun to receive broad based international attention, most notably under the ICT4Peace Project. The ICT4Peace project proposes that ICT has a role in conflict prevention and management, humanitarian relief, and post-conflict peace building and reconstruction and aims to highlight its use.

The relationship between ICT and peace is germane to the UN as the largest multilateral contributor to post-conflict stabilization worldwide, particularly to its Department of Peacekeeping Operations (DPKO) and Department of Field Services (DFS). These are the UN organs responsible for guiding, organizing and operating UN PSO and peacekeeping personnel.

### 3.2 Past Communication

ICT was hitherto unavailable to peacekeepers and therefore a core issue addressed in the Brahimi Report which discussed the need for a new peacekeeping strategy and organization to support emergent PSO requirements. The report recommended that an EISAS composed of information system specialists, military analysts and criminal network experts be formed.\(^{[3-4]}\) Threaded through several parts of the report where references to the need to better link the peace and security system together in order to facilitate communications and data sharing.

This was to ensure PSO personnel had the tools to perform optimally while enhancing UN effectiveness at preventing conflict and mitigating the
effects of war. Additionally the report noted that the UN at the time had no IT center for user-level strategy and policy for peacekeeping and thereafter recommended the development of a PSO extranet with access to the EISAS and other data bases. The resolution for change was timely because the UN had experienced systemic failures due in part to the fact that PSO forces were unprepared for the changed nature of missions as ICT often went to war fighters and not PSO personnel. \[3-5\] [3-6] [3-7]

Although the EISAS has not been established, the Brahimi report started a quiet paradigm shift and in 2007 the UN General Assembly authorized the reorganization of the DPKO and the establishment of the separate DFS. The restructuring aims to ensure unity of command and integration of effort. There has also been a range of other initiatives to ensure integration within UNHQ, field missions and all actors to collect, analyse and pass information such as upgrading the DPKO’s WAN to support instant messaging and support computer conferencing.

### 3.3 Present Information

The evolution of peacekeeping suggests that PSOs differ by degrees of consent, use of force and applicability of impartiality. The issue of demonstrating a mission’s impartiality or reinforcing credibility is sometimes a matter of who wins the airwaves. The philosopher Nietzsche suggests that “there are no facts only interpretations” and the interpretation of communities in conflict and external actors themselves often depends directly on perception and information. Unfortunately the
stress of the conflict situation can distort perception of actors in the field and only timely and present information can “fight” this.

The nature of the tactical environment is also different. Current PSO missions are carried out in full glare of the public and caught between extremes of consent levels so that personnel are more likely to deal with crowds than armies and ownership of land and cattle than buffer zones. Minor incidents can be embellished or presented with a partisan viewpoint, almost immediately by global news networks with the effect that parties to the conflict and their allies are aggravated. This presents fluid situations that quickly spiral out of control at the tactical level such that the strategic end-state seems untenable.

More so the scale and requirements of UN PSO experienced today was totally unimagined decades ago. Multi-dimensional PSO with large contingents of military and civilian elements also have to contend with the absence of telecommunication infrastructure on ground. This could either be because they have been eroded by the conflict or because there never was any to start with. The resulting theatre of chaos can damage unity of command, visibility and simultaneity of effort between the DPKO/DFS, mission HQ, its contingents and other PSO actors such as aid agencies and journalists. This has been seen in the Somali civil war, Rwandan genocide, collapse of Yugoslavia and war in Iraq.

In order to more fully address the complex requirements of modern PSO the new-look DPKO now focuses on giving strategic direction, management and guidance to PSO and includes a new Rule of Law and
Security Institutions office and an expanded Office of Military Affairs. The newly created DFS is responsible for operational support and expertise with four organizational divisions overlooking the areas of personnel, finance and budget, logistics support and ICT.

The separation of ICT from logistics support underpins the relevance currently accorded to Communications and Information Services as the division is further divided into two sections, an Operations section and an Information Systems section. There has been a determined effort to surmount the myriad of new situations being experienced daily and in 2007 alone UN peacekeeping operated:\textsuperscript{[3-9]}

- 40,000 desk top computers
- 2,800 servers
- approximately 3.5 million emails and 2.5 million phone calls routed every month (approximately 1 per second)
- 200 video conferences per month translating to roughly 2,400 for the year.

It is too early to evaluate the effects of UN peacekeeping ICT reform because the restructuring is fairly recent and comes at a time when the UN System as a whole is undergoing reform while the physical structures of the UN Secretariat in New York City are under renovation.\textsuperscript{[3-10]} It is already evident that ICT has several significant applications in modern PSO. This paper does not attempt to identify all its uses as the rapid march of science and technology churns up new solutions daily nor does it attempt a critique as there is a dearth of information.
Integrated ICT systems are an important tool when designed to support information sharing, communication and decision making in multi-lateral operations. Therefore the rest of this chapter will focus on the potential applications and enhancements ICT could afford UN PSO at both the Strategic Level and the Mission Level. The Strategic level refers to the UNHQ, DPKO, DFS and the organ in respective TCC responsible for UN PSO while Mission level refers to the PSO in the field and its links to other actors.

3.4 Strategic Applications

3.4.1 Force Generation

The UN launched the UN Standby Assistance System (UNSAS) in the mid-1990’s in order to enhance its rapid deployment capabilities and to enable it respond to the unpredictable and exponential growth in the establishment of complex new generation peacekeeping operations.\textsuperscript{[3–11]} Notwithstanding the seemingly large numbers of personnel indicated by Governments to be available and listed on the UNSAS database of military, civilian police and civilian assets the memorandum of understanding confirms that States have their right to “just say no” to a request from the Secretary General to contribute such asset to an operation.

Unfortunately quite a few Member States say “no” to deploy formed military units to the UN-led PSO a lot more than they say yes especially western countries that have the requisite logistics. In contrast to the tradition of developed nations providing the bulk of troops for United
Nations PSO during the organizations first 50 years, in recent times a greater percentage of troops deployed for UN PSO are contributed by developing nations.

This can be evinced from cursory analysis of the Monthly Summary of Contributors (Military Observers, Police and Troops) to UN PSO missions as at 31 January 2008.[3-12] The top ten contributors of Uniformed personnel according to DPKO records as at December 2007 had Pakistan as the lead followed by Bangladesh, India, Nepal, Jordan, Ghana, Uruguay and Nigeria in 8th position though Italy and France occupied the 9th and 10th spots. The use of an agile database marker that could instantly indicate the availability of troops and proactively solicit reserves from TCC could prove advantageous in the generation of forces for new missions.

The joint AU–UN operation in Darfur (UNAMID) unanimously approved by the UNSC on 31 July 2007 is a case in point.[3-13] With 26,000 personnel the hybrid force will be the largest UN operation since interventions in Yugoslavia and Somalia in the 1990’s. Although researchers on the Future of Peace Operations Program at the Stimson Center suggest that “it will likely be the most challenging and complex UN peacekeeping operation since the Korean War” there is still a dearth of western troops or hardware.[3-14] This is despite the fact that the UN is only expected to provide roughly 10% of the personnel requirement it has been unable to meet up with the quota nor has the AU TCCs which require UN logistical backing to meet up with their 90% quota.
To this end it has been suggested that the UN develop further the minimum training, equipment and other standards required for forces to participate in UN PSOs. UN Member States with the means to do so have been called upon to form partnerships to provide financial, equipment, training and other assistance to troop contributors in developing countries to enable them reach and maintain this minimum standard. One major way to provide training and monitor standards could be through optimum use of ICT.

3.4.2 Training Applications

ICT uses in training are varied depending on the intended objective and may be deployed in several ways due to the availability of low cost tools and techniques. For instance, the Nigerian Armed Forces Simulation Center (AFSC) which is co-located with the Peace Keeping Training Unit in Jaji has been used by Nigerian authorities to develop and provide a virtual environment for training potential PSO commanding officers. They undergo simulated exercises in joint sea, air and land PSO operations targeted at potential hotspots within Africa. This has proved helpful in enhancing the cadre of middle to senior level officers deployed by Nigeria in its PSO activities. Possibly a major reason why the country is internationally lauded for its vast experience and commitment in contributing men and materials to PSO for various local, regional and international conflicts.\textsuperscript{[3-15][3-16]}

The Institute of Creative Technologies (ICT) located in Marina Del Ray, California is another facility that is involved with accelerating the
availability of tools and techniques to develop training applications under a contract between the US Army and the University of Southern California. The institute used its Experiential Learning System to aid personnel learn through active military training tasks by creating an immersive virtual environment including diverse terrain, deployable assets and situational context. When peace keepers are trained by such ICT developments they can learn how to function in varying environments before they ever come into the conflict zone. A vivid example of this was described in the October 2000 edition of Christian Science Monitor magazine under the heading, “Army enlists Hollywood to help Harden its Soldiers”.

In the UNITAR POCI Commanding United Nations Peacekeeping Operation manual, Ford (2004), observes, “The UN must constantly adjust to new conditions and new needs and at the same time continue to meet its Charter and enshrined principles.” A major advantage of ICT type training is that the software used in ICT training is constantly changing and highly adaptable. Therefore it can be modified at will to reflect the current tactical environment and physical space. This is important because when properly used ICT can be both a process and structure that continuously adapts to the present mission situation.

3.4.3 DPKO Situation Center

The DPKO situation center has a crucial role to play as the point of contact at UN Headquarters for all DPKO and DFS field missions while providing 24-hour communication link between UN HQ, field missions,
humanitarian organizations and TCCs. The Situation Center gathers information both from the field and other sources such as the internet. It is also responsible for notifying permanent missions (PM) of any casualties or injuries to their nationals. The conference room in the Situation Center is already used for video conferences with field missions. It also enables DFS staff interact with the Senior Missions Leaders, such as the Force Commanders (FC) of ongoing missions.

The typical operation is that the PSO field HQ would receive information from the different aspects of the field mission and then the FC would brief the Situation Center Staff what was relayed to him. In gathering the information however mission HQ staff receive oral feedback mainly from patrols and other ground observation methods such as patrols.\textsuperscript{[3–19]} When such information is radioed in to mission HQ there is a time lag between reporting observations in remote locations to sector HQ and then to the relevant decision-making authority to authorize prompt action. The Srebrenica Massacre is an example of what happens when proper authorization can not be obtained on time as the Dutch units felt abandoned by the HQ at Sarajevo.

However new ICT technology suggests that the use of small, light weight internet protocol (IP) based internet connections in tandem with conventional satellite uplinks hold great promise of enhancing physical human monitoring. The portable transmission gear fits into a regular back pack and can enable the instant relay of breach in agreements or cease fire violations direct to the mission HQ (or even UNHQ) such that the personnel in the field can also directly join up in a real time Video
Conference. This use of technology was first used by the news broadcaster Cable News Network (CNN) during its coverage of the Israeli–Hezbollah conflict in July 2006 and subsequently won CNN a top prize in the September 2007 IBC Innovation Awards.\textsuperscript{[3–20]}

As soon as the information is promptly relayed to the Situation Center the human components of the Crisis Action Team can be quickly summoned for the initial crisis management. Often a video conference with the FC or head of mission will take place either routinely or as urgency of the situation dictates. Video conferencing is particularly important when information has to be relayed first hand to high level authorities and could be vital when air transport can not be immediately obtained or for missions in conflict areas of less developed and remote regions where the road network is non-existent. Inadequate road and terrestrial communication networks is a typical feature of modern conflict regions and have recently been linked as a cause and effect of under-development.\textsuperscript{[3–21]}

Furthermore, advances in video hardware and software have lead to an increased ability to process more rigorous algorithms for video and audio while higher performing IP networks are allowing new technological advancements in the conference arena.\textsuperscript{[3–22]} This could make telepresence achievable so that face-to-face interaction allows DFS HQ staff coordinate, collaborate and communicate with field operations as if actually on ground.
Telepresence unlike tele or video conferencing enables the users keep eye contact, read body language and interact in real time environment by using High Definition (HD) video and audio technology. Collaboration features already available with Cisco telepresence allow users work together on documents or presentations.\textsuperscript{[3-23]}

This could prove a novel interplay of ICT in PSO command, control and data handling. However for the employment of such a responsive ICT infrastructure to provide an accurate early warning mechanism in times of crises, enhance rapid response and collaborative capability, reliability will need to be increased by creating automatic filter of false alarms and use of encryption to address concerns of organizational security.

3.5 Mission-Level Applications

3.5.1 Conflict Mitigation and Information Operations

ICT can be used to guide or force combatants and civilians of disputing nations away from conflict. Komov (1997) noted that ICT has a range of uses from “distraction, pacification and appeasement to intimidation, misdirection and downright provocation of opposing forces.” His list is germane to PSO tasks since they suggest that depending on usage ICT can help slow or prevent the use of force. In many instances the role of the UN mission is to facilitate conflict resolution and not to impose a solution. The threats to this would be from groups trying to use disinformation, rumor and propaganda to cause discontent between
various parties in order to exacerbate potential feelings of dissatisfaction and disenfranchisement within the population.

Therefore timely flow of information both within the mission contingents and via information operations (IO) to the mission area at large will help dispel rumor mongering and present the facts in such a manner as to associate credibility, transparency and impartiality to the mission. The IO in IFOR, Multinational Division North (MND–N) is instructive in this regard. The task force commander encouraged civil affairs, public and psychological operations (PSYOPs) experts to work together with intelligence analysts and combat arm planners and operators to form an effective IO working group.\(^{3-24}\)

Colonel Boltz, who was the operational public affairs officer for MND(N) responsible for coordinating the Commanders Information Coordination Group, went on to note that the chief of psychological operations in MND(N) broadcast press releases via the PSYOPs radio station and also published some of the same information in the native language Herald of Peace Newspaper which was distributed to the locals. She went further to observe that success in sharing and transmitting information from press releases was due to clear communication both within the command and to the local audience.

It is important to distinguish between PSYOPs when employed in conflict and when used by a PSO force. During conflict situations PSYOPs conventionally refers to propaganda however in a PSO effort PSYOPs could be used in an effective Information Campaign such that all actors
from the PSO mission conduct a truthful and harmonious IO that enhances transparency from all parties in the mission area while also engendering credibility of the PSO mission.

Another example can be drawn from the Geneva–based War Torn Societies Project (WSP) which works at promoting reconciliation and social integration among populations in crisis zones. For instance, in Somaliland villagers were shown videos of elders from other clans talking about daily problems common to all communities, and in Sierra–Leone video clips of rebels saying they wanted to negotiate an end to conflict were shown in opposing villages. In Rwanda video enabled Hutus and Tutsi discuss the genocide and its aftermath in more comfortable settings. Such approaches are simple but powerful when employed by a PSO mission to mitigate conflict and build the peace.

Inducing greater information exchange and dialogue between local communities could build local capacities for collective problem-solving in post-conflict situations. ICT through internet, radio and providing faster communication transmission links is a major enabler of IOs and conflict mitigation. The strategic end-state for the PSO mission may be to influence the affected people in its area of responsibility towards creating an atmosphere of security, trust and understanding. This has a direct impact on peace building because these are the conditions for a stable environment in which businesses and markets flourish, children attend schools and families live without fear.
3.5.2 Simultaneity of Effort

One of the key challenges in the PSO mission field is that so many players are necessarily involved. The UN and its specialized agencies are constantly conducting a wide range of activities around the world in response to international situations and to ensure unity of effort there’s need to liaise between various missions, programs, agencies, offices and country teams in support of individual PSO missions. Additionally the mission is typically made up of military and police contingents from various TCC as well as civilian elements either hired as field staff or from interested actors. As the office of the Undersecretary for Readiness in the US Department of Defence notes “Lessons learned from Operations Enduring Freedom and Iraqi Freedom demonstrate joint and coalition operations will be the norm, rather than the exception, in the future.”[3–26]

Current world trends suggest there is a need to use innovative technology to enhance command, control and coordination in the PSO theatre and also provide concerted training for such interagency, intergovernmental and multinational effort. ICT can support concurrent efforts at tactical, operational and strategic levels. This is important because a PSO mission is typically part of an overall strategy to help resolve a conflict and requires the parallel conduct of political, economic, development, human rights and humanitarian efforts.

For instance the Spectrum Simulation Capability simulates the actions of several interagency groups all working together in a PSO environment.[3–27] If developed such a process could demonstrate where help is needed in the PSO theatre and what combination of agencies on ground would be
most effective in a particular situation. Another effort is the Global Aggregated Model for Military Assessment (GAMMA) prototype software which is used by NATO in the Multinational Experiment (MNE) series to provide modeling and simulation support to an MNE effects based approach to operations (EBO). The EBO is an emerging and improved way of planning and conducting operational campaigns based on a holistic understanding of the operational environment taking all instruments of power of the political, military, civil and economic (PMCE²) spectrum into account.⁴⁻²⁸

The use of the decision making tool was deemed necessary because as MajGen Bjorn E. Kristiansen notes, “The Organisation (NATO) will see new and broader alliance operations in conflict prevention and crisis management: Peacekeeping, humanitarian operations, and disaster relief and also stabilization and support to reconstruction.” He also expects that there will therefore be a derived need for NATO to harmonise efforts with other actors like International Organisations (IOs), National Governments, Non-Governmental Organisations (NGOs) and Industry.⁴⁻²⁹ This supports the need for coherence of effort and the use of ICT to achieve that coherence by simulation training and practically on ground.

### 3.5.3 Mission Orientation and Specific Training

The Training and Evaluation Service (TES) now incorporated into the Integrated Training Service (ITS) of DPKO has a three-phase “Mission HQ

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⁴⁻²⁹ MajGen Bjorn E. Kristiansen is the Assistant Chief of Staff (ACOS) Implementation of the NATO Allied Command Transformation (ACT). He was speaking at the Conference on Defense Transformation, at Garmisch-Partenkirchen, Germany,
Orientation Programme” to address the needs of integrated management of UN peacekeeping field missions. The three levels of the standard training module (STM) are targeted at different objectives. The first part, STM1 is the Generic training for all TCCs and PCCs personnel. STM2 is specialist training for Logistics Officers and UN military observers while STM3 is the Senior Mission Leadership courses and aims to develop a pool of middle and senior level leaders who may participate in future UN peacekeeping field missions over a two-week course culminating in a command post exercise.\textsuperscript{[3–30]}

The DPKO has also assisted TCC to undertake mission specific training for individuals and contingents before deploying to the mission area. This training covers the background and conditions relating to the UN authorizing the Peacekeeping mission, history and characteristics of the region and parties to the conflict. Such training can be conducted online using the World Wide Web (WWW). This will ensure that the Mission Orientation Program is standardized for the different contingents that make up the PSO mission.

The current practice is to check the training of personnel when they arrive the mission area.\textsuperscript{[3–31]} However it could prove more effective if PSO personnel from different TCC are mentally and professionally in accord prior before they ever enter the mission area. Full spectrum peacekeeping training has been suggested for all components much before deployment on PSO.\textsuperscript{[3–32]} This is because the knowledge, skills and attitudes (KSA) required for a PSO totally differ from conventional military methods. The war in Kosovo aptly illustrated the problem of using war fighting
techniques to achieve humanitarian ends.\textsuperscript{[3–33]} Efforts will therefore need to be made by UN DPKO and TCC to harmonize contingents understanding of individual mission requirements \textit{before} joining the mission.

In depth cultural training about the conflict should be seen as a priority before arrival and thereafter supplementary induction training may be performed on arrival. The Australian contingent to operation restore hope was relatively successful because it adopted the strategy of researching and learning the Somali custom ever before they arrived the country. Consequently, while the behavior of a few members of some contingents damaged the missions credibility the Australians actions in Baidoa enlisted local support.\textsuperscript{[3–34]}

Already UNITAR POCI offers low-cost distance training to peacekeepers, potential peacekeepers, police and humanitarian workers world-wide through e-learning and printed courses which are subsidized to personnel already on UN missions.\textsuperscript{[3–35]} However these courses are on a voluntary basis and not mandatory for potential personnel. Perhaps some of the courses such as the \textit{Introduction to the UN System: Orientation for serving on a UN Field Mission}, \textit{Principles for Conduct of PSO} and \textit{UN Military Observers: Methods and Techniques for Serving on a UN Observer Mission} could be made sine qua non because the knowledge provided was immense.

More importantly since mid 2006, UNITAR POCI in cooperation with the UN DPKO Integrated Training Service (ITS) has been offering the same training to all African and Latin-American peacekeepers, military, police
and gendarmerie personnel under the auspices of its E-Learning for African Peacekeepers Programme (ELAP) and E-Learning for Latin American and Caribbean Peacekeepers (ELPLAC). This is a laudable step in the right direction and shows innovative use of ICT however, it is only available to personnel already deployed in the mission area.

One issue could be actually identifying what personnel will actually be part of a mission. This could be solved by offline interaction between the Force Generation Service (FGS) which administers UN SAS and TCCs to identify potential peacekeepers on short call. Although the training of PSO personnel is a national responsibility and prerogative, UNITAR POCI can provide added but crucial mission orientation and specific training.

3.5.4 Information Sharing in Theatre

In a large number of peacekeeping situations the UN mission has to work closely with regional and sub-regional organizations in order to achieve the objectives of the mission. Firstly because the UN Member States that provide civilian, military or police contingents for UN peacekeeping missions may also be members of regional, sub-regional or other collective security arrangements. Also there is often already the presence of international non-governmental organizations in theatre ever before the mission is established. The institutional experience and knowledge of local customs and traditions which these organizations have garnered is often an asset that needs to be harnessed.
This is the norm rather than the exception. As Ford (2004) notes the UN has needed to cooperate with wider international and regional organizations to address the concerns in a localized area such as the Balkans, in Central America, in the Great Lakes region of central Africa and now more recently with the AU in Darfur. In other cases military forces from regional organizations have worked alongside UN contingents. Historic examples include the deployment of UNAMSIL into Sierra Leone with ECOMOG still present, the operation of French soldiers under Operation Torquoise in Rwanda while a scaled down UN force was present and the Commonwealth of Independent States (CIS) peacekeepers cooperating with the UNOMIG observers in Georgia.

With diverse actors in the mission area it is important to ensure that an optimum solution is churned out by harnessing the capabilities of all the actors in a holistic manner. This could be achieved by developing operational agreements, memorandum of understanding, liaison arrangements, regular meetings and exchange of information at the operational level. Information sharing is particularly essential to establishing and maintaining an atmosphere of cooperation among PSO actors as they perform their respective activities. Timely and efficient information sharing is at the heart of unity of effort. Communication would be simpler and information sharing easier when the PSO actors in theatre are in close proximity and homogenous with a common language and culture.

However these utopian conditions of homogeneity and spatial relationship do not often exist in typical PSO. The resulting frequent communication
barrier must be overcome as inability to communicate and share information is one of the most common complaints among actors in the PSO environment. Even with a willingness on the part of contingents and other actors on one hand and the deployment of state-of-the-art technologies at the other, a usual experience is that the physical equipments cannot interface. There is therefore a need to standardize communication facilities first within the Mission HQ and also with other actors in the PSO theatre. This seems rather impracticable as nations have traditional suppliers of relevant communication hardware, however, ICT could provide a ready communication interface with such technologies as Voice over Internet Protocol (VoIP) and use of internet messenger for instance.

Regional Organisations and NGO’s bring the advantage of familiarity with local dialects and the region which can be harnessed by the UN PSO mission. Consequently as Donna Boltz (2001) highlights in her article “Interoperability—Talking From Day One”, planners of peace support operations could use ICT to bridge culture and training gaps, shorten time and distance while also expediting relationship building. There are significant advantages that can occur if the actions of all the PSO actors are properly coordinated and dovetailed together in a constructive manner. When they are not coordinated chaos results which could be fatal for personnel in the mission area. The 2002 movie Guerreros details how fatal the routine task of restoring electricity to a village in the Kosovo Exclusive Zone was to a Spanish engineering platoon on NATO assignment due to inadequate communication.
3.5.5 Compelling Compliance

Although it sounds far fetched, ICT can compel compliance by simulating actions and consequences depending on the requirements. An example occurred in the negotiation for the Dayton Accords where significant territorial issues had to be resolved and maps became a significant part of the negotiation currency. Digital mapping was used such that negotiators viewed in alarming detail the positions of their forces and understood that the mission HQ was fully aware of their every move. Also another example of compelling compliance was via simulations used at the same Accords. Digitized map information such as points, lines and areas in vector form where pulled into a PowerScene™ terrain visualization system and presented to negotiators as still screen shots, fly-through videos or dynamic fly-through by using a joystick.[3-37]

Four effects of this approach were obvious. First it afforded the parties the benefit of accurate and undeniably consistent visualizations of their negotiation positions on ground and what needed to be done as any realignment of real or negotiated boundaries could be reflected in automated recompiations of areas. Secondly it allowed for flexibility and responsiveness of support such that it was possible to make a tentative negotiation decision and within six minutes see exactly what effects and requirements that would be needed in an interactive manner.

More importantly and possible not easily noticed was the fact that regardless of how time-consuming and trivial the negotiators request, personnel where able to set up ICT processes to do the task endlessly and
without complaint. This gave external and internal actors confidence that no gross blunders would occur because somebody got tired. Lastly greater transparency was enshrined as negotiators from different sides often had to work with computer operators who were not on their team.

The use of digital mapping may prove even more useful in subsequent PSO as the issues for intra-state conflict turn from ideology to issues such as land and the necessity for delineating cease fire lines, zones of separation and control zones. This is already the case in the Darfur region of northern Sudan where the conflict has been linked to clashes over water and land. There was no clear cut all-in-one process to achieve the requests from the negotiating parties. The experience further proved that no matter how advanced the technology, some workarounds will always be required to keep up with expectations. The lessons learnt from the Dayton Accords could possibly prove useful to UNAMID as they will have to compel the conflicting parties to cease fire by showing that urgent action is being taken to address the issues at a stake.

### 3.5.6 Consent Promotion

There are no real distinct compartments for the PSO in the spectrum of tension or consent and the constantly changing notions and degrees of consent preempt a need for consent promotion. News reports abound with the conflicting interests in mission theatre and the tragedies that befall UN peacekeepers when caught in uncertain situations. Erstwhile UN Secretary-General Kofi Annan referred to this need for PSO forces to find new capabilities for what he called *positive inducements to gain support*
for peacekeeping mandates amongst populations in conflict areas.\[^{3-39}\] He observed that future PSO will require greater coercive ability but could not rely on this alone as it is better to attempt to influence people in conflict situations through the use of *carrot* rather than the *stick*. Coercion can restrain violence temporarily but it cannot promote lasting peace.\[^{3-40}\] Durable peace and a sustainable solution require more than just stopping violence but providing the enablement to ensure that the same precipitating condition does not remain.

Unfortunately the presence of the military element of the PSO force in the theatre of operations does not always inspire local support. This could be for a variety of reasons from commercial as was experienced during the Bakara Arms Clearance Operation in Somalia to emotional as seen with the infamous Hadzici Women of Bosnia and Herzegovina.\[^{3-41}[3-42]\] In the former ridding the market of weapons meant stopping the cash inflow to parts of the community due to the outlawed trade in weapons. While the women mounted a human blockade to prevent military relief vehicles into the town in protest of what they perceived to be the wrongful arrest of their men folk.

In both situations the PSO effort had to display tact and widely disseminate information to show impartiality of the missions’ position before the tactical end-state could be achieved. In Bakara the aim was to increase regional security by confiscating the illegal weaponry and in Hadzici it was to prevent further deaths from starvation by getting humanitarian relief supplies to the needy city. Therefore to preserve impartiality and not *cross the Mogadishu line* or perhaps find itself taking
sides and being drawn into the conflict there is a need for the PSO mission to employ consent promoting techniques to reduce the chances of undesirable escalation.

The management of consent is based on the principles of impartiality, legitimacy, mutual respect, minimum force, credibility and transparency. There is also a parallel to the techniques of promoting good communication, negotiation and mediation, and positive approaches to community relations. Current PSO doctrine suggests six sets of techniques designed to maintain consent in conflict areas where PSO personnel are deployed.\textsuperscript{3-43} These techniques are:

(a) Negotiation and mediation
(b) Liaison
(c) Civilian affairs
(d) Community information
(e) Public information and
(f) Community relations.

The major objective of consent promotion is to provide accurate and timely information to reduce rumour, uncertainty and prejudice while also engendering trust, stability in the conflict area and positive perceptions of the PSO mission and personnel. Liaison is vital to link the PSO actors such as the mission itself, communities, and civil authorities, parties to the conflict, aid agencies and the media. The purpose is to ensure the timely exchange of information, to notify intentions, lodge protests, co-ordinate activity, manage crises and settle disputes.\textsuperscript{3-44}
Although startling the use of elementary equipment like walkie-talkies and VHF hand-held radio is still germane to PSO as a fast method of communication within short distances. This can be enhanced by provision of wireless internet in respective Area of Responsibility (AOR), use of VoIP, Satellite phones such as the new Inmarsat ISAT phone and BGAN satellite terminals for instance.

An adhoc system in a village for instance would merely require compatible handsets or walkie-talkies and a base station. The base station will act as a radio relay and could consist of a computer and transmitter/receiver connected to an antenna. For mission HQ level to village communications, the base station(s) could be connected via WAN to another computer that acts as a Mobile Switching Center (MSC). Portable towers with satellite links may provide an option for creating micro-cells that could permit further frequency re-use in situations where the number of walkie-talkie users have overloaded this makeshift communication systems.

3.6 ICT Summary

The use of ICT in C4ISR and for achieving the MDG is well known, however, its use in promoting peace and PSO is less investigated. The ICT4Peace project is a recent international effort to highlight the relevance of ICT to peace efforts. In the past ICT went to the war-fighter but the Brahimi report has led to amongst several others, the July 2007 restructuring of UN peacekeeping to ensure unity of command and
integration of effort as well as other initiatives to upgrade the DPKO WAN. There is now an entire division in the DFS devoted to information and communication operations.

Although it is too early to ascertain the effects of ICT in peacekeeping reform there has been remarkable success with the volume of deployed ICT assets. These are further proof of the relevance of ICT to modern PSO as well as underscore the need to optimize solutions that meet current challenges at strategic and tactical levels. For instance timely information is essential to demonstrating a missions’ impartiality as well as reinforcing its credibility while inadequate communication architectures could lead to chaos.

At the strategic level ICT could help in maintaining management logs in force and logistics generation while automatically matching shortfall or surplus to planning needs. Also the adaptability of software ensures that ICT can enhance simulation exercises and training even over long distances to ensure that the personnel that are available can properly use specialized logistics. Use of portable transmission gear with IP to satellite links and immersive display technology could enhance prompt relay of information from ground elements via telepresence type video conference.

There are even more uses of ICT at mission level. ICT can play a role in mitigating conflict, information operations and coordinating efforts between other agencies and NGOs in theatre. The internet, VoIP and messenger are particularly useful for communication when hardware is incompatible. Standardised cultural and specific orientation can be carried
out before personnel enter the mission area via long distance web-based training. ICT can enable information sharing between the mission and NGOs in theatre, compel compliance amongst conflict parties by vivid display of information concerning violations by either actor, and promote consent by show of impartiality.
4. SATELLITE REMOTE SENSING AND PEACE SUPPORT OPERATIONS

4.1 A Different View Point

Satellite Technology has been available for over four decades. Most of this time however, it was mainly used in the military and scientific fields by privileged few who could muster the resources. During the cold war military “spy satellites” kept tabs on the activities of potential adversaries using remote-sensing technology. By the end of the cold war such abilities and data were essential in determining troop movements and violations of international treaties. The Gulf War saw new uses as early-warning satellites, originally orbited to detect strategic missile launches against the US, proved effective in detecting the launch of the smaller, Scud, missiles against allied targets. This early warning capability gave the Patriot antimissile batteries time to prepare for the Scuds. [4-1]

The ability to see without being seen has held great interest for humanity and rapid advances in technology combined with dramatic reductions in costs have enabled the use of satellite resources by a wider community. Consequently Remote Sensing (RS) and its associate technologies such as GIS and GPS now impact the conduct of science, government and business alike. [4-2] Space is no more the domain of super powers and by the end of super power rivalry in the early 90’s countries such as France, Israel, India, Canada, Japan and Europe had ended US and Russian dominance of
satellite earth observation by launching satellites with sub 10m resolution.\[^4-3\]

Surprisingly, Africa has not been left out of space. In 2002 and 2003 Algeria and Nigeria launched 32m resolution satellites into Low Earth Orbit (LEO) becoming the second and third African countries to have a presence in space after South Africa.\[^4-4\] Additionally in May 2007 Africa’s first communications satellite the NigComSat-1 was launched into geostationary orbit with footprints over Africa, part of the Middle East and Southern Europe.\[^4-5\] Nigeria is also on schedule to launch a very high resolution 2.5m satellite to replace the first satellite when its orbit life expires in 2009.\[^4-6\] Although these efforts are directed towards the developmental goals of the respective countries the capability they provide could enhance PSO in Africa by enabling communications and providing information on ground situation ranging from activity on military installations and around arms storage areas to route traffic and refugee movement.

The DPKO is uniquely positioned to harness this potential because there can not be any meaningful development without peace and security which is the typical environment a typical UN PSO seeks to create. More so UN peacekeeping is warming up to the importance of space–based assets having deployed 450 satellite earth stations since its restructure in 2007 alone.\[^4-7\] This is a viable option because Africa has the lowest tele-density statistics world wide only ameliorated by advances in mobile satellite communications. Therefore as a large number of present UN missions are in Africa the PSO mission is most likely to deploy in areas
lacking accurate maps and terrestrial communication infrastructure and to harness the potential afforded by space based resources there will be need to train for space.

4.2 Training for Space

The UN System has considerable experience in training for the use of space assets. The UN Programme on Space Applications (PSA) is currently being implemented by the UN Office for Outer Space Affairs (UNOOSA). The UNOOSA is the office responsible for promoting international cooperation in the peaceful uses of outer space.\(^4-8\) The PSA has seen to the conduct of training courses, workshops and seminars in remote sensing, communications, satellite meteorology, search and rescue, basic science and satellite navigation to name a few.

The UN actually has sufficient capacity to provide more advanced training. In accordance with General Assembly resolution (45/72) of 1990 The UN established five regional centers for space science and technology education. They are:

1. The Center for Space Science and Technology Education in the Asia and Pacific region (CSSTEAP) located in India.
3. The African Center for Space Science and Technology Education in English Language (ARCSSTE–E) located in Nigeria.
4. The Center for Space Science and Technology Education in Latin America (CRECTEAL) with campus in Brazil
5. The Center for Space Science and Technology Education in Caribbean (CRECTEALC) located in Mexico.

In addition to implementing training courses, workshops and other activities with the support of the host countries, they also offer post graduate level courses in RS and GIS, Satellite Communications, Satellite Meteorology and Global Climate and lastly Space and Atmospheric Sciences.

In the year 2006 ARCSSTE–E (Nigeria) had 87 eligible foreign applicants for the GIS/SRS PGD Programme. After due consultations with the National Space Research and Development Agency (NASRDA) of Nigeria, ARCSSTE–E was able to offer 20 scholarships to foreign applicants to cover the costs for tuition and living expenses, while the travel support was covered partially by travel grants received from UNOOSA.\[4-9\] Perhaps the UN DPKO could facilitate an arrangement with UNOOSA to enable DFS Staff attend similar workshops. This will ensure personnel have knowledge on the possible applications to meet the needs of current and future missions.

4.3 Technology on Location

The availability of low cost RS data has been enhanced by the declassification and commercialization of US and Russian satellite imagery as well as US decision to stop intentional degradation of GPS signals. Lastly the wide spread availability of user–friendly GI software and
internet driven computers has further encouraged public–private partnerships in RS data and service.\textsuperscript{[4–10]} As a result there are several sources for high resolution commercial satellite imagery that could be used for PSO. Depending on application requirements the resolution required could be spectral, spatial, radiometric or temporal. A list of possible sources of satellite imagery and their applications is at Annex B.

Although the cost of the use of such imagery may range from hundreds to several thousands of dollars the DPKO/DFS can benefit from the use of the UNGIWG’s planned Imagery System Contract (ISC) whereby UN agencies use the multi-agency licensing option when purchasing imagery. Commercial satellite providers typically subject the usage of provided data to strict copyright agreements implying that images can not be used outside the mission area or a specific operation. Therefore ISC could allow for use and re-use of imagery and sharing this imagery with the field missions as well as major host nations involved in the dispute. While also enabling DPKO leverage on the experience of UN agencies like the WHO, FAO and OCHA who have considerably more remote-sensing metadata.

Another issue of concern to DPKO use of satellite imagery was the typically long lead time between request and delivery of imagery as well as revisit times.\textsuperscript{[4–11]} However the use of Cisco Low Earth Orbit (CLEO) Router by the UK’s contribution to the Disaster Monitoring Constellation (DMC) showed that mobile networking is possible for connecting across disparate and separate networks for ground stations in different continents.\textsuperscript{[4–12]} The UK DMC–1 satellite successfully demonstrated that
satellite command, telemetry and data delivery could be handled based on IP and related commercially used standards.

This evolutionary break through suggests that a satellite in space can be treated like an internet node using the CLEO router and the IP-based VMOC (Virtual Mission Operations Center) software application such that space and ground based assets maybe seamlessly merged. Therefore a participating virtual ground station in Darfur for instance can access a particular satellite regardless of the fact that the satellite is not on a pass over that ground station. A virtual ground station does not need to have the facilities that a normal ground station has other than a computer, internet connection and the relevant application software. This is something the UN Logistics Base (UNLB) at Brindisi may find as an interesting addition to the DPKO WAN.

4.4 Possible Partnerships for Use of EO Assets

Space is not the exclusive preserve of any one nation or organisation. There are several successful partnerships exhibiting this notion that can benefit UN peacekeeping in a variety of ways. The advantage of being involved in possible partnerships from established actors includes learning from their experience and the ability to procure data and services from multiple providers.

The DMC operates as an international consortium whereby each satellite in the constellation is built and owned by individual organizations but
launched into the same orbit and operated cooperatively.\[4–13\] This arrangement allows the partners and the representative company have greater access to imaging opportunities as well as reducing the lead time between images. The DMC already has helped with UN efforts at monitoring the cultivation of opium in Afghanistan by providing detailed satellite imagery and analysis of the entire country.

This sort of international partnership could be imitated so that TCC with the requisite earth observation capabilities provide satellite imagery to DFS logistics support division under the dry lease arrangement and at reduced cost. Fortunately several of the top TCCs such as India, Pakistan, Nigeria, France and Italy already have sufficient EO capability.

The UNITAR Operational Satellite Applications programme (UNOSAT) is a non-profit consortium headed by UNITAR but implemented in concert with the UN Office for Project Services (UNOPS) and European Organization for High Energy Physics (CERN).\[4–14\] This is another option that can be explored. UNOSAT already has the special relationships with private-sector RS service providers as well as experience in procuring GI products for UN agencies particularly those involved in the international humanitarian and development communities.

UNOSAT offers its services free to any institution involved in humanitarian activities aimed at crisis prevention and management in-line with UN policies.\[4–14\] Therefore DPKO/DFS and field missions are qualified to use UNOSAT (and its extensive partners) round-the-clock RS
service and support in satellite imagery selection, procurement, and image processing to name a few.

Other possible options for broad international and inter-agency public-private cooperation include the Disaster Charter, UNGIWG and the RESPOND consortium. The Disaster Charter originally conceived by ESA and CNES in July 1999 to provide users the opportunity to request priority access to partners EO satellites now has several national space agencies including US, Canada, India, Argentina, Japan and Nigeria as members. During Hurricane Katrina the NigerSat-1 was among the first satellites to obtain images of the unfolding hurricane.\textsuperscript{[4–15]} Although the charter has been made freely available to all UN agencies it only covers those involved in natural or man-made disasters.\textsuperscript{[4–16]}

The RESPOND consortium is a large but informal group of European partners that has committed itself to making geomatics more accessible to the humanitarian community by improving access to maps, satellite imagery, GI and analysis.\textsuperscript{[4–17]} The RESPOND consortium was able to quickly meet the operational challenges of humanitarian organisations working in Darfur. DPKO regularly sends representatives to attend UNGIWG meetings which are a positive step however it may need to leverage on its influence with TCCs as well as UNOSATs membership of the RESPOND consortium to further enhance cheap access to satellite imagery and expertise. This will help in strategic and tactical level planning as well as Observation and Monitoring in theatre.
4.5 Planning Imperative

At the DPKO/DFS strategic level the major application of RS will be for top level strategic planning. For an effective PSO, proper planning, preparation and execution must occur at a number of levels. Planning is a multi-disciplinary effort because current PSO’s involve diplomatic, economic and humanitarian activities in pursuit of political objectives and not just military. At the strategic level planning the Executive Committee on Peace and Security (ECPS) and DPKO would necessarily meet. However operational planning for the PSO mission necessitates several reconnaissance trips in theatre by DFS staff. These trips are essential to enable planners collect useful information on terrain, infrastructure, transportation facilities and prospects for accommodation. At this point the availability of high resolution imagery could enhance information collecting, surveillance and reconnaissance especially when merged into a multi-layered GIS database.

Ford (2004) posits that the PSO preparation cycle involves 3 distinct phases viz the Initial Development Phase, the Pre-deployment Phase and the Deployment phase. In the first phase field conditions that determine the nature of overall operational activities are observed with a view to developing a planning concept for the operation. In the next phase and based on the planning concept a more comprehensive plan taking into account the resources and requirement is developed while the last phase is mission critical during which the UN must establish the mission as quickly as possible in the Area of Operations.
Use of Satellite Imagery could be helpful all 3 phases, particularly in gathering planning information when the time frame for planning is insufficient, the terrain is impassable or when the situation on ground does not permit adequate access for UN officials. This is particularly true in the case of intra-state conflicts or when one party has something to hide. In order to increase pressure on the Sudanese President Omar al-Bashir to end the violence and also urge the United States and others to plan a multinational peacekeeping force in Darfur, the American Association for the Advancement of Science (AAAS) analyzed high-resolution commercial Satellite Imagery which gave evidence of destroyed and threatened villages in Darfur.\textsuperscript{[4–19]}

The AAAS use of satellite imagery was to mount pressure on the UN (and Member States) to actually pass a resolution and authorize a sizeable PSO force for Darfur. It is quite possible that the derived images amongst other factors where used for arriving on the required force size and logistic requirements.

The use of multi-layered GIS data also helped UN administrators and PSO forces plan then implement a proper refugee resettlement strategy in Kosovo in addition to delineating ethnic expulsion patterns. GIS applications combined information about refugee returns, minefields, unexploded ordnance, potable water, housing and lines of communication.\textsuperscript{[4–20]} This data was used in the settlement planning as well as to correlate the pattern of ethnic expulsions.
4.6 Monitoring and Observation

When properly carried out monitoring could be crucial to confidence building and consent maintenance for the field operation particularly with the asymmetric nature of modern conflict. To emphasize its importance, as at 31 December 2007, there were 17 UN sanctioned peace support operations and a further 3 DPKO led–special political and/or peace building mission, and all 20 of them included monitoring as part of the mandate.\textsuperscript{[4–21]} Monitoring and Observation tasks in peace support operations serve to detect and deter threats, verify agreements or resolutions, and to supervise or assist with field activities.

Monitoring is germane to PSO whether the mandate is Chapter VI or VII backed. Military forces supporting peace operations monitor sanctions, military activity, police activity, elections, and the physical security of regions, demilitarized zones, and PSO camps.\textsuperscript{[4–22]} Non-technical monitoring is manpower intense and relies mainly on human detection and observation conducted via patrols, observation posts, and checkpoints. In hostile regions or complex operations, the demand for personnel to conduct monitoring missions is greater.

There is a need to optimize available resources and reduce manpower demands in peace support operations by using remote sensor monitoring technologies. This view was also canvassed in the Brahimi report which notes that PSO could benefit greatly from more extensive use of GIS technology, which quickly integrates operational information with electronic maps of the mission area for applications as diverse as
demobilization, civilian policing, voter registration, human rights monitoring and reconstruction”[4-23]

The application of ground remote sensing to monitoring is not altogether new and has historical precedence. The Sinai Field Mission (SFM) which ran from 1976 to 1980 used four unattended ground sensor fields with TV and infrared scanner technology to supplement human observers in monitoring the Giddi and Mitla passes which separated the Egyptian and Israeli forces during the staged withdrawal process. The monitoring technology was used in an open and relatively unprotected manner because the SFM considered “traditional” peacekeeping, had a high consent and low force requirement.[4-24] The technology was eventually discontinued because of a political decision to employ a large and visible force instead of electronic monitoring.

Recent monitoring technology options include the Canadian reconnaissance vehicle Coyote which has a suite of electronics that allows for video, audio and radar intelligence information collection.[4-25] It has onboard GIS that combines a television camera, thermal imager, laser range finder linked to GPS, ground surveillance radar and modem for wireless transmission of the collected data. This provides a variety of monitoring data that can be directly transmitted to relevant decision making authorities promptly.

Budgetary constraints, national interests and public support often affect resources available for PSO. Satellite monitoring could compliment human monitoring and help reduce costs in the long run by making the
environment safer while enhancing the neutrality of the mission. This is particularly so when all imagery obtained is provided to all parties. A party to the conflict could be politically or militarily sensitive to having satellites take images of certain structures or areas. Therefore as part of the mission mandate and SOFA, all parties may have to agree to the use of satellite imagery for monitoring to avoid such security concerns.

4.7 SRS Summary

Several events have made the benefits of satellite technology more widely available and developing countries who are the largest contributors to UN PSO have not been left out. UN peacekeeping is uniquely poised to take advantage of the RS capabilities of TCCs/PCCs, however there will be a need to provide DFS staff with more exposure to the technology through partnership with UNOOSA affiliated schools in Brazil, India, Mexico, Morrocco and Nigeria.

The UNGIWG proposed ISC is one method of group purchasing high resolution imagery from commercial satellite imagery providers and DPKO/DFS can leverage on the contacts and experience of frequent users of SRS and GIS data within the UN system. The possible use of VMOC type software will enable greater flexibility in sharing downloaded data among missions as well as reducing lead time between request and delivery of images.
A DMC type collaboration between TCCs and PCCs with EO assets could be harnessed to provide low cost imagery, processing and analysis to DPKO/DFS under a dry lease arrangement. Other possible RS partnerships for peace could involve UNOSAT, Disaster Charter signatories and the RESPOND consortium. This will benefit planning at DPKO/DFS level as well as mission level observation and monitoring when high spatial resolution imagery is used.
5. IMPLEMENTATION AND SCENARIO

5.1 Introduction

Mechanisms for implementing ICT and RS for UN peacekeeping must be both facilitative and adaptive. General prescription of an ICT infrastructure will limit the possibilities of coordinated response both within the DPKO/DFS HQs but also within the field missions. This could adversely affect the desired tactical and strategic end-state. Consequently in terms of applying ICT the question to be asked then answered is who needs to talk to whom, when and why? This has broadly been answered in section 3.4 and 3.5 of this thesis.

However for RS the skeptical questions of Pyrrho may hold a clue: what is being secured? What is it being secured against? Who provides security? Lastly what methods can be undertaken to provide it? \[5^{1}\] Answers to these questions vary with situation and required application. At the tactical level the situation can vary widely within a given time frame depending on the location of the contingent and the perception of real and imagined threats. However the applications of RS to PSO though numerous are more definite and a few will be highlighted below. For instance SRS can assist in:

- Demobilization Operations by identifying areas with large amounts of armed combatants using high spatial resolution images. The people and the weapons may not be adequately identified from space however the
settlement patterns and effects such as pollution from destroyed villages and change in vegetation owing to large numbers of people can be seen.

- Conflict prevention and Military Assistance by identifying areas where systematic violations have occurred such as “suddenly” empty areas or burnt villages. Before the outbreak of conflict the tell tale signs of structural conflict and ideological violence leading to “cleansing” of certain areas can be seen by observing the changes in topography compared with archaical evidence. A GIS system can also be used for conflict mapping and predicting of possible outbreaks of violence even before they occur.\textsuperscript{[5–2]} Thereafter an interposition force could be placed along the fault lines ever before the conflict erupts into physical violence.

- Humanitarian Relief and Convoy Protection. A practical example of how this can be implemented by a GIS field officer to plan a route for a relief convoy will be seen in section 5.2 below.

- Establishment and Supervision of Protected Areas by delineating separation zones agreed to by the parties in the conflict. Satellite imagery will provide a neutral view point and allow the parties accept and comply with the provisions of such agreements. Digital mapping could also help in negotiations as witnessed prior to achieving the Daytona Accords. The Russian GIS Project Sentinel in Kosovo combining military–mapping data with dynamic information helped prevent renewal of battle action, created conditions for refugee return and helped in demining operations.\textsuperscript{[5–3]}
• Mine Awareness and Mine Clearance Operations. The Information Management and Mine Action awareness Program (iMMAP) is an NGO which already has substantial experience in using GIS technology to define the scourge of landmines and explosive remnants of war (ERM). Data can be obtained from satellite imagery with high spectral resolution. Thereafter the data can aid the PSO field mission better co-ordinate with relevant agencies in the field as well enable improved decision making.

• Sanctions Monitoring and Guarantee or Denial of Movement. The same principles required for planning a relief route from the mission will apply to ensuring sanctions are upheld or movement is denied about a designated safe area.

• Counter Drug Operations. Satellite imagery from hyper-spectral sensors can aid in the detection of illegal drugs in cultivation or development as well as monitor established drug traffic routes. This can be done directly and indirectly. Hyper-spectral imagery can be used for direct monitoring as certain plants yield slightly different spectral signatures at different phases of the growth cycle when compared to other crops. Moderate to high spatial resolution imagery can aid indirect observation as the presence of large PVL pipes, processing and transport infrastructure in suspected regions can be indicators of illegal drug farms.

• RS data can also be used in Non-combatant Evacuation operations, Counter Insurgency, Counter Terrorist and Combat Search and Rescue. However in order to properly achieve the set objectives it is really important to know what to look for and what tools (sensors and processing
software) are available. The case scenario that will be looked at will try to show a simple but practical application of RS/GIS to a UN PSO field mission and what programmes have been implemented by other actors in the field so far. This underscores the need for greater collaboration between DPKO/DFS and other advanced users of GIS/RS in the UN System such as FAO and WHO.\textsuperscript{[5-4]}

5.2 Hadzici Relief Road Project

This sample application and case scenario is presented below.\textsuperscript{[5-5]} It suggests the thought process of a GIS Officer on a field mission working within certain limiting parameters, however, in a real situation much of this work may already have been done by specialized UN agencies and programmes such as FAO and WHO, or other NGOs and consortiums such as iMMAP or RESPOND. The scenario is set in the Balkans. A unit is required to provide cover for a humanitarian relief convoy trying to deliver supplies to the starving inhabitants in the town of Hadzici and the commander tasks the GIS Officer to locate the best route using RS technology. If the GIS/RS Officer in the field mission is fortunate to have the imagery already provided in a data base, then unlike the scenario, he will only have to identify the best option and present to his commander and there will be no need for the exhaustive process below.

5.2.1 Mission Objective and Assumptions

The mission objective is for the GIS officer attached to a UN PSO mission with responsibility over the town of Hadzici to provide the best route for humanitarian relief supplies through thick forest, avoiding swampy areas,
high topography and with minimum contact with the restive local population. Assumptions are that cloud cover is an issue and also the DFS has invoked the Disaster Charter with support from the Red Cross and OCHA, therefore the GIS officer can call on the EO sensors of any of the national space agencies signed to the charter.

5.2.2 Concept of Operations
The CONOPs would be to identify what data is required, what parameters can be measured to provide the data and lastly what available sensors can be used to obtain the data. Thereafter a GIS database would be created and information presented to the commander showing possible routes for the commander to make a decision.

Firstly, the GIS officer will require RS data on:

- Topography. He may decide to avoid observation by plying a road that does not run over high topography and noting likely ambush points on the route.
- Population Distribution. Identifying and choosing a route that avoids areas with large amount of population.
- Vegetation. He may or may not choose to route through the dense part of the forests with sufficient cover or maybe avoid the forests altogether.
- Wetlands data. Swamps would need to be avoided as the PSO mission would expectedly prefer not to incur the extra costs (or noise or time waste) of constructing bridges or drainages.
Essentially the human aspect of the project is to identify the sensors required based on the parameters expected to be measured. Thereafter any number of processing software can be used to process the derived data and display in a form that can be easily understood by the decision making authority i.e the Officer–in–Charge (OIC) or FC.

5.2.3 Sensor Options

The choice of sensor would depend on the parameters to be measured. Different features such as grasses, forest canopy, water, urban features etc reflect and absorb solar radiation differently at different spectral wavelengths. Thus they can be differentiated by their differing spectral reflectance signatures in the resulting images. Optical remote sensing systems such as multi-spectral imagers have the ability to detect the variations in spectral signatures owing to reflected solar energy.

The principle is that when microwaves strike a surface, the proportion of energy that is returned back to the sensor depends on many factors. These include:

(a) Physical factors such as the dielectric constant of the surface materials (itself depending on strongly on the moisture content);
(b) Geometric factors such as surface roughness, slopes, orientation of objects relative to the beam direction.
(c) The types of land cover (soil, vegetation or man–made objects) and
(d) Microwave frequency, polarization and incident angle.
A possible solution could be to use a variety of sensors and form a GIS model so that the layers present a multi-layered view of the area. This is what the RESPOND consortium did in Darfur.\textsuperscript{[5-6]} Imaging radars are some of the recent alternatives to a variety of RS devices used in assessment of Earth resources or environment monitoring. They have the ability to penetrate vegetation canopy making them useful for topography mapping in thick forested areas, when stereoscopic capabilities are available. The Synthetic Aperture Radar (SAR) can provide high-resolution imagery independent of weather or sunlight. Additionally there is a large return ratio from land as against water as a result of the contrast in dielectric properties and surface roughness providing an interface which enhances coastal delineation and other mapping applications such as flooding identification, wetland and hydrological mapping.

Therefore the GIS officer could employ Multisensor Image Merging (MIM) such that SAR imaging is used to acquire topography information and wetlands data while vegetation cover is obtained by use of a multispectral sensor. The availability of a very high resolution panchromatic imager to take high resolution imagery would be an added advantage but sensors such as IKONOS are commercial and unless under some alliance (Like RESPOND) may prefer to first satisfy requests from scheduled customers unless images of Hadzici are already in the company archive.\textsuperscript{[5-7]}

\textbf{5.2.4 Parameter Measurement}

The intricate working of the various RS sensors in space will not be of importance to the GIS Officer since different satellite designers achieve the same objectives with various instrument designs. However the
parameters to be measured are essentially the same. Vegetation has a unique spectral signature which enables it to be distinguished readily from other types of land cover when viewed in an optical or near infra-red (NIR) image.

Reflectance from vegetation is low in the blue and red regions of the electromagnetic spectrum due to the absorption of both wave bands by chlorophyll for photosynthesis. However it peaks in the green spectrum which is why it is coloured green. Therefore vegetation can be identified in NIR (0.7 – 1.5μm) where there is more reflectance than in the visible band (0.4 – 0.7μm) region where Panchromatic (Pan) imagers and human vision operate.

The SAR will achieve greater penetration using the longer wavelength L band (1 – 2 GHz) than the C band (4 – 8 GHz). This means that while the shorter wave interacts with the top layer of the forest canopy and is reflected the L–band penetrates deeper into the canopy where it undergoes multiple scattering between the canopy, trunks and soil. The level of backscatter indicates the object being identified. Vegetation covered surfaces give diffused returns, calm swampy water will be more specula and buildings (indicating human presence) will yield higher back scatter. More importantly the SAR allows for construction of a stereo image of the target area by using two different incident angles.

There will also be need to confirm the data derived from the sensors with known and credible archived data as well as know what sensors are available within countries signed to the disaster charter. The NOAA
Landsat data is a free and widely available source of archived data while the Japanese Earth Resource Satellite (JERS-1) can provide SAR imagery and the NigeriaSat-1 can provide multi-spectral imagery.

5.2.5 Data Processing/Information Extract

There could be need to subject the raw data to radiometric correction by nearest neighbor re-sampling in order to correct for uneven sensor response over the received image. This may either be done by the GIS Officer and his team or the receiving ground station before ever sending to the GIS Officer in the mission area. There is often also need to correct the received data from geometric distortion due to the Earth’s rotation and other imaging conditions such as oblique viewing. The images can then be transformed to conform to a specific map projection system and depending on the required accuracy geo-referenced to align the received data with a precise map.

Furthermore to distinguish the dense forest areas from less dense the vegetation index (NDVI) will be computed from the equation NDVI = ((NIR – Red) / (NIR + Red)). Thick dense forests will have a higher NDVI from less dense areas. Mapping the NDVI to display colour guns will show vegetated areas in bright tone and none vegetated areas such as population settlements and rivers will be dark.

The SAR data will be geo-coded with terrain correction while speckle noise will have to be suppressed by applying speckle remove filter. In this case population centers will appear bright and vegetated areas will have intermediate tones. This is because buildings return very strong energy
due to corner reflection while trees with more moisture (perhaps due to growing in swamps) will return more energy than trees with less moisture (maybe in non swampy areas) and the mixture of both results in the intermediate coloured areas on the image.

After taking special care to interpret the radar images and noting that reflected radiation is best taken in daylight and cloud free condition the GIS officer will then resample all the information to a common grid before integrating into a GIS where the he outlines the features. Thereafter using the GIS model he can select the safest route that meets the mission objectives. Lastly, he may then present the data to his commander for a decision. In keeping with the commanders wish, the chosen route will pass through low terrain and the less dense part of the forest while avoiding swamps and population nerve centers.
6. CONCLUSION

Without a specific mention in the UN charter, PSOs have emerged the number one global strategy and mechanism through which the UN addresses conflict. The dramatic increase in the number and complexity of modern conflict, has forced a more comprehensive international response via multidimensional PSOs, These sometimes involve a range of conflict prevention, peacemaking, peace-keeping, peace enforcement and peace building activities. This modern era has also been marked by an equal rise in technological advancement leading to the availability of low cost communications, satellites and remote sensors for all actors in the conflict arena.

UN peacekeeping has had to cope with increasingly rising expectations but shrinking resources. The changed situational environment has affected the tactical and strategic end-state so that a different concept of operations is necessary. Challenges to an effective PSO run the course from before conflict, during the conflict as well as post conflict peace building activities and they affect the political, military, economic and cultural-civil spheres. The interplay of several external and internal actors with different motives and interpretations often makes the peacekeeper on ground a target.

In order to meet up with the new but complex challenges there has been structural reform in the way UN peacekeeping operates, to allow strategic planning from DPKO and effective operations management from DFS. The rise in modern requirements on PSO from planning to operations has been
matched by a phenomenal increase in technological applications for
information gathering, knowledge management, communications and
remote sensors.

For UN peacekeeping to remain relevant as the number one global crisis
response mechanism and strategy, there will be need to optimize secure
but affordable off-the-shelf technology solutions to meet up with
emergent opportunities at strategic and mission level. Several UN
specialized agencies have already developed proficiency in the use of ICT
and SRS having garnered the requisite skill, experience and public–private
partnerships that can benefit UN PSO. UN peacekeeping will have to
harness these ready opportunities within the UN system as well as reach
out to a myriad of consortiums and initiatives that promote the use of ICT
and SRS to the wide range of conflict resolution activities.

For instance, within the UN a system wide strategic ICT network is being
developed and progress is being made to better integrate ICT solutions
for UN agencies and programs in line with current reforms. The approach
is vintage UN, highly consultative and bottom–up and therefore although
thorough, will take time before properly completed. Moreover, the reasons
that necessitate use of information and communication systems differ
among different aspects of the UN system and therefore the DPKO and
DFS will need to optimize efforts of the ICT network to provide ICT
solutions to meet challenges at strategic and mission level.

There are several working groups within the UN that afford cooperation
on RS issues such as the GIST and UNGIWG. The UNGIWG in particular
has broad inter-agency membership including DPKO. The group works towards better interagency collaboration on a wide range of GI issues including all aspects of RS and the use of satellite imagery. The DPKO and DFS stand to benefit from UNGIWG efforts but will however be responsible for optimizing the benefits to meet up with differing strategic and mission level objectives.

UN peacekeeping already has used satellite imagery in its operations and since its re-organization in the past year alone operated hundreds of satellite ground stations as well as improved the DPKO WAN to cope with large communications traffic. There will be a greater need to address typical concerns such as lead time between request and delivery of images as well as availability of cheap metadata with high spatial and spectral resolution. This thesis made some suggestions to how these challenges can be addressed through partnership, use of UN good office and the disaster charter as well as implementation of virtual ground stations such as the VMOC.

Several UN specialized agencies and programs already have considerable institutional experience in the use of SRS and GIS technology for complex humanitarian emergencies. Such agencies also have cooperative agreements with specialized NGOs and other bodies. The DPKO/DFS can benefit by harnessing the expertise provided by greater collaboration with such advanced users of GIS/RS in the UN System such as FAO and WHO. This can be done by regular meetings such as under the auspices of UNGIWG or GIST but more direct contacts will need to be made configure the applications at the strategic level. Additionally access to in theatre
training and support will need to be provided for relevant DFS and field mission staff. It is evident that DPOK/DFS will need to lead efforts at identifying the mechanism, relationships and standards necessary to implement a spatial data infrastructure germane to peacekeeping. The DPKO Lessons Learnt Unit could also research into other avenues of cooperation.

To reduce the costs required in greater use of ICT and SRS technology there is need to harness the same off-the-shelf ICT infrastructure used by commercial organizations world wide. Security will not be an issue because with the trend of globalization and increasing competition amongst organizations, commercial ICT vendors and their target users are security savvy. Therefore UN peacekeeping can actually benefit from use of cheap, secure and reliable COTS solutions.

This thesis examined the use of SRS and ICT and provided opportunities for enhancing the achievement of modern PSO. Areas where the use of such technology would prove effective in current and future missions were mentioned. Chapter One introduced the necessity and potential for ICT and RS in PSO. Thereafter the conceptual frameworks including a detailed prognosis of UN PSO evolution was discussed in Chapter Two. The relevance and applications of ICT to PSO Strategic and Mission levels was followed by a discussion of how RS can be better used by UN peacekeeping. Both chapters ended with a summary of the main points. A detailed but technical scenario of mission level application of RS to PSO was covered in Chapter Five while Chapter Six was the conclusion.
REFERENCES


http://leav-


[1-12] Disaster Monitoring Constellation presentation last accessed 19 September 2007 from Sharing Earth Observation Site web link at http://directory.eoportal.org/pres_DMCDisasterMonitoringConstellationALSAT1BILSAT1NigeriaSAT1UKDMCBijing1.html


[2-10] Email discussion “Difficulties of change from an AU-led to UN-led mission” between the student and Navy Lieutenant MY Olowu who is the public relations officer grade II in the office of the UNAMID Force Commander.

[2-12] Report of the Secretary General, UN Doc A/3289 of 4 November 1956


[2-17] Odofin, B., “Role of the Nigerian Navy in Peace Support Operations” Lecture delivered during the Peace Keeping Week at Danjuma Hall, Armed Forces Command and Staff College to Junior Division Course JC59/05 in March 2005
montenegro.suite101.com/article.cfm-serbia_presidential_election_2008


[2–24] Tutor2U Introduction to ICT last accessed online at http://tutor2u.net/business/ict/intro_what_is_ict.htm


[3–7] According to Professor Tom Woodhouse and Dr Tamara Duffey in the UNITAR POCI course note, “Peacekeeping and International Conflict Resolution” pg 89 the failure of the UNAMIR mission and the general response of the international community was attributed to “Africa fatigue” which affected the judgments and motivations of the main powers in the UN System. Particularly after the experience in Somalia where 18 US peacekeepers will killed on 3 October 1993. However ICT was willingly deployed in the gulf war.


[3–19] Email discussion between student and LtCdr A Oride a current peace keeper on location at UNAMID


[3–23] Macus Gallo European marketing manager, Unified Communications Cisco Inc interview with Keri Allan of Institute of Engineering Technology


between 9 – 11 April 2006 at George C. Marshall Center Garmisch-Partenkirchen, Germany
last accessed 19 October 2007 from


[3–31] Ford, T., “Commanding United Peacekeeping Operations” a Course Produced by the United Nations Institute for Training and Research, Programme of Correspondence Instructiiion. Pg 71


[3–33] Ercolani, G., “Security Dilemma: Dealing with Fear, Uncertainty and Interpretations an Intellectual Path through Two Courses Global Terrorism & Peacekeeping and International Conflict Resolution” Lecture delivered as part of Approved UNITAR POCI Class room course at Lecture Theatre 1 Clifton Campus Nottingham Trent University (NTU), Nottingham, United Kingdom on 12 March 2008.


[5-1] UNITAR Classroom Discussion at Nottingham Trent University (NTU) on the topic Security Dilemma: Dealing with fear, Uncertainty and Interpretations, An Intellectual Path Through Global Terrorism,
Peacekeeping and International Conflict Resolution held at Lecture Theatre 1, Clifton Campus, NTU on 13 March 2008.

[5-2] This is already being used by some NGO’s in the Great Lakes region of Africa. However Satellite imagery is not the sole indicator as the NGO’s combine it with various other ground truth reports from eye witnesses, observing radio stations and other data sources.


[5-4] To a large extent this is already being done at the organizational level as DPKO regularly sends members to the UNGIWG meetings though it is not apparent if DFS has participated since it was formed in 31 July 2007.

[5-5] This is just a hypothetical example nor should it be mis-construed with the earlier mention of the 300 Hadzici women who held up relief supplies to the town of Hadzici. Although named after the town, it is actually motivated by the tragic fate that befell a group of Spanish peacekeepers in the movie Guerreros.

[5-7] This is just my thought and can not be independently verified until the GIS officer requests the commander to purchase the data. Its quite possible the satellite will already be scheduled to pass over the Hadzici area or perhaps there are already images of the area in the Ikonos Archive.


ANNEX A

Total Troop Contributors to UN PSO as at Jan 08

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Totals: Police     11,254  
UNMO           2,877  
Troops        76,752  

Grand Total:     90,883
## ANNEX B

Table B – 1: Sources and Possible PSO Applications of Commercial Satellite Imagery

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