Technologies to Support Peacekeeping Operations 12

by
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(Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-740-Eng-48).

INTRODUCTION

The first task of a peacekeeping strategy and peace enforcement is deterrence. The peacekeepers must be able to deter aggression but not incite hostilities in a crisis between belligerent entities. While this suggests that the introduction of peacekeeping troops in a crisis should be perceived as defensive in nature, it also suggests that the mere presence of ground forces neither provides new incentives for politically motivated aggressive acts nor inhibits the use of other military options. The introduction of Marines into Lebanon as a peacekeeping force in 1983 was apparently perceived to be sufficient. Rather than deterring aggressive action, however, the Marines became a target of opportunity for a militarily meaningless but politically valuable low-risk attack. The result was the loss of 241 American lives.[1] In Somalia, the initial humanitarian objectives were rather quickly accomplished due, it is argued, to the introduction of a massive force clearly capable of quickly and decisively accomplishing its objectives against any possible opposition. Once the surprise and shock of the initial deployment wore off, U.S. forces were reduced, the warlords adjusted, and the presence of United Nations forces became more of an incentive for hostile action than a stabilizing influence for peace. One paradox of peacekeeping operations is that peace keepers often become the targets of retaliation (as for example, currently in the former Yugoslavia).

[1] The World Almanac and The Book of Facts (New York; Pharos Books, 1991) page 727.

A force deployed in a peacekeeping operation must have the capability to avoid being provocative while possessing the strength to deter warlike actions and, if necessary, counter any retaliation with minimal non-lethal force. The attributes needed by peacekeeping forces to provide deterrence are similar to those needed to fight, but the emphasis should be on perceived capabilities. To be successful requires quality troops and leaders provided with the right equipment (technologies) at the right time, used the right way (doctrine/tactics), and tactics.

BACKGROUND

The peace keepers must be clearly perceived as having the unquestioned capability to accomplish their mission when and where employed. The prerequisite is that these peacekeeping troops, no matter how small in number, must be able to protect themselves against any likely opposition. It is not enough to rely on the belief that a rational enemy will not attack for fear of overwhelming retaliation. The peacekeeping force must be capable of responding to random or well-planned terrorist attacks and/or conventional force engagements. The deployed peacekeeping force must be trained and well equipped to respond to any challenge and have exceptional versatility. The force must be capable of providing intelligence and be equipped with affordable and appropriate technologies to hold their own and to offset numerical deficiencies. It needs to be more than helpless troops "armed" with blue berets, yet it cannot be perceived as hostile to any or all. One possible approach to this is the application of "Non-Lethal Weapons" (NLW) to defend themselves and achieve their mission. These will be discussed in the section on NLWs.

First, as opposed to Kuwait, peacekeeping land forces were sent to Bosnia-Herzegovina by some nations prior to an air strike, with light equipment and were dispersed widely, therefore vulnerable to retaliatory actions on the ground, They found themselves, therefore, in the worst position for land combat, a situation that the United States tended to underestimate since they were not directly concerned. It remained possible, though, to provide these troops with close air support or with air-to-air interdiction actions against enemy aircraft; such a scenario was to constitute the first military action in NATO's history, on 28 February 1994, nearly forty-five years after its creation. But even assuming it is always possible to send fighter bombers to support ground troops, there will always be a reluctance to do so just to neutralize a single mortar, even one firing on the people of Sarajevo or Bihac.

An architecture needs to be developed which covers the many facets of peacekeeping operations: truce monitoring; cooperative military disengagement; confidence building; humanitarian relief; refugee support; peace enforcement; and early steps of post-conflict rehabilitation. The structural elements of this architecture rely on: intelligence situation awareness; survivability; and a response capability of non-lethal force projection to threats. Some of the technologies required to support this architecture are covered in the sections on sensors, mine detection and clearing, non-lethal weapons, and other issues related to survivability. Clearly a peacekeeping operation should not inflict losses nor suffer losses.

SENSORS

There are a large number of specialized sensors that can provide peace keepers current situational awareness and intelligence. This real-time data can allow for sufficient response time if counteraction is required. A brief description of the variety of sensors follows.

- **Micropower Impulse Radar (MIR):** The MIR is a new radar sensor that has numerous applications in peacekeeping operations. Based on emitting and detecting very low amplitude voltage impulses, it is the first active radar with continuous multi-year operation from small batteries. Its low power drain and wide bandwidth also make it very covert, eliminating both interference and interception. The MIR motion sensor, for example, has a sharply defined detection range, multi-year continuous-use battery life, exceedingly low emissions, broad area or omni coverage, and very low cost. It can be used for short-range intrusion detection or perimeter defense or other security applications. Another use of the radar is remote detection of human motion; this could be to remotely detect breathing and respiration rate or heart motion, making it an excellent tool for hostage rescue operations and for battlefield medicine. In addition, multiple MIR sensors can be combined for a wide range of imaging applications. MIR arrays and software for imaging people behind walls for surreptitious entry, buried mines, and locating thickness and composition of walls have been developed. Its features include variable depth (range) resolution, wideband pulse for fine cross-range resolution, briefcase sized for portability, and two-dimensional imaging in less than 10 seconds.

- **Wavelength Tunable Video Camera (WTVC):** The WTVC is a compact framing hyper-spectral imager with pointing and tracking capability designed for airborne spot survey applications in searches for stressed foliage and waterborne effluents from covert chemical plants and buried facilities. Stressed foliage could indicate camouflaged facilities or hidden armored vehicles and other items concealed under foliage. The system is extremely compact; the camera payload is housed in a 14-inch diameter 4-axis gyro stabilized gimbal and is ready for airborne deployment. The image handling system incorporates a frame grabber that digitizes the analog input. The framing architecture of this imager supports data collection modes that are consistent with real time hyper-spectral image processing since, unlike conventional push broom and whisk broom multi-spectral scanners, the camera does not require platform motion to generate the image.
- **Hand and Air Deployed Sensors for Field Intelligence:** A family of intelligent unattended ground sensors has been developed which could form the basis for a number of peace violation indications and warning systems as well as active defense control. The current family consists of seismic, IR, magnetic (2-axis), and nuclear sensors with projects underway to include low power ultra-wideband spread spectrum radar, and various chemical sensors. Onboard multi-sensor data fusion techniques reduce the incidence of false identification and alerting. When suitably reduced in size, these sensors would provide a means for perimeter emplacement, and base camp monitoring as well as the ability to locate threat forces in a preestablished grid of checkpoint sensors. Air delivered components and systems have been developed.
- **Electronic Tags for Monitoring:** Micro-miniature, high security, electronic tags have been developed for uniquely identifying components. Recent advances in this technology have added the capability to store information in the tag in non-volatile memory over extended periods of time. Remote interrogation via RF line of sight and satellite has been demonstrated. Connection to assess local indicators of readiness to perform is possible.
- **Advanced Night Vision:** The next generation Night Vision System known as GENIV will have more than two times greater resolution over its predecessors and three times the gain with 40 percent higher signal-to-noise ratio. This will lead to a three-fold improvement in target detection and identification ranges under starlight conditions. It will also provide higher contrast images, night vision with a larger field of view, and operation in urban environments eliminating the halo effect or blooming when city lights are in the field of view.
- **Laser Imaging Spectroscopy:** An Imaging Fourier Transform Spectrometer has been developed. This instrument produces a complete infrared spectrum of every point in its image. This spectrum is a fingerprint of the materials or gases which are contained in that pixel, and can be used to identify chemical effluents and identify materials remotely using

only passive detection. It is currently a ground based system and is being used for chemical vapor detection studies, and for the detection of buried mines. The concept can be extended to airborne or space-borne systems. A new generation of the instrument that will significantly improve performance is being developed.

- **Remotely Piloted Vehicles (RPV):** For surveillance purposes there exist a wide spectrum of RPVs that can act as scouts. These RPVs can be as inexpensive as the largest model airplane equipped with a small video and a fiber optic link to much larger systems. The larger systems can carry tens to hundreds of pounds of sensor systems. The U.S. Department of Defense has a significant development program underway to develop RPVs and a whole host of sensors. These RPVs will have long endurance and can operate at low to very high altitudes and in some cases are virtually undetectable. These RPVs will carry state-of-the-art miniaturized imaging sensors in a variety of wavelengths (visible, LWIR, UV, etc.), as well as synthetic aperture radar for imaging. They will be accompanied by sophisticated computational capability to provide automatic target recognition.
- **Robotic/Autonomous Systems:** The United States is developing a new system called the Wide Area Mine (WAM). WAM can detect, identify, and track targets. Although its original intent was to defeat these targets, it has the sensors and computer power to emulate many functions of peacekeeping troops acting as sentries by using this backbone as a surveillance tool. In the section on non-lethal weapons we discuss the transformation of the WAM lethal smart warhead with non-lethal components. In the future we may see autonomous “sentries” the size of match box toys that patrol with sophisticated sensors and networked communication systems.

MINE DETECTION/CLEARING

Mines present a serious deterrent to peacekeeping forces. Not only can they kill and injure, but they also provide a large psychological barrier to the conduct of operations. More over, they leave a lethal legacy of death and dismemberment after hostilities are over. It is estimated that there are from 180 to 225 million unexploded items of ordnance that are residual from previous hostilities. For example, 75 years after WWI France’s Department du Déminage estimates there are 12 million unexploded shells remaining from conflicts near Verdun. In Angola, two decades of no-holds-barred civil war may have left 20 million land mines in the earth, which kill 120 Angolans each month. In Cambodia 300 people are killed or maimed each month. One mine remains in the ground for every two people in that country. In Afghanistan 12 million mines were laid during the 1980s war with the former Soviet Union. In the former Yugoslavia, 60,000 mines are laid each week; and in northern Somalia and the Mozambique highlands, millions of mines ring native villages and water holes. Mines have replaced human soldiers as sentries, stopping humanitarian aid from flowing in and keeping refugees from flowing out. Land mines are plentiful and cheap, costing as little as $3 each. The U.S. State Department estimates upward of 85 million mines spread across 56 nations. The United Nations, estimates 105 million mines or more deployed in 62 nations, or one mine for every 50 people on earth. Further, it is estimated that about 350,000 mines and/or unexploded ordnance are cleared every year, but about 2.5 million mines are emplaced every year. One has to find the mines, circumvent them and/or destroy them, both in military operations and in peace. Mines exist on land (buried or surface), in the coastal region (surf zone) and at sea. In the coastal region mines in the form of antipersonnel, anti-armor, tiltrod and small moored mines, are also interspersed with obstacles such as concertina wire, hedgehogs, log posts and concrete blocks.[2]

Mine warfare is very low tech but effective. The countermine activity gets a lot of lip service, but no effective, long duration-funded program has been sustained to tackle the operational and peace aspects of this problem. The best countermine/counter-obstacle strategy is to prevent their use. Non-lethal or precision/intelligent technologies may provide a path for effective area denial prior to an assault. An obvious example is the preemptive mining of contested territory with self-neutralizing mines, carrying non-lethal weapons as in the case of a revised WAM system. An ideal approach is to have pre-surveyed the site of interest constantly via overhead coverage to allow observation of mining operations as they occur.

If preventive measures fail, a two-step process is required. First, mines must be located. Secondly, once located, they must be removed or destroyed. There are traditional and not very satisfactory methods used to locate these mines, such as magnetometers and gradiometers, electromagnetic induction detectors, ground penetrating radar and others. The advent of plastic mines has rendered most of these techniques useless.

While concepts are evolving, with various rates of success, for handling different parts of the land mine problem, there is still no solution for finding buried or obscured mines. Because they are buried, they offer no obvious signature to conventional detection methods such as cameras, lasers, or conventional radar. Current studies have shown that the few signatures that these targets offer are subtle and they may require multiple sensors to provide sufficient detectability. To date, studies have focused on single or multiband IR signatures of mines or mine fields. Due to the difference in thermal diffusivity of explosives in either plastic or metal cases, there would normally be a slight change in temperature as the area goes through a diurnal cycle. Unfortunately, clutter and emissivity of shadowed regions cause difficulty. In addition, ground penetrating radar has met with some success, but it also can be spoofed by clutter.

Because of the enormity of the problem and its difficult nature, we suggest that the problem of obscured and buried mines not be neglected. Numerous technologies, including newer ground penetrating radar systems, multi-spectral and hyperspectral imaging systems in the visible and infrared, or even acoustic techniques, should be studied, particularly together as multisensor systems. Such work will provide a definitive answer to the question of whether the problem is solvable, even in part.

Finally, it is important that studies limit their scopes to specific, interesting scenarios. In the past, workers in the field have been stalled by the definition of the problem—find all mines in all conditions. Progress in this field may be limited to certain types of mines in certain environments. Program planners should look to the world where problems exist and ask for solutions that, though they may not be perfectly general, do work in those specific cases. Partial solutions are better than none at all.

There are two new techniques that may offer some promise: Micropower Impulse Radar (MIR) and hyperspectral imaging. MIR has recently been tested to evaluate its viability as a mine detection sensor. These tests show that MIR reliably detects both plastic and metallic land mines and mine surrogates buried in both moist and dry soils. The MIR sensor technology provides several advantages over existing GPR systems including: low cost, low power, lightweight and compact size, and the ability to assemble into compact arrays. Coupled with 2-D and 3-D imaging algorithms, MIR offers the potential for a low cost, high performance mine detector that will enhance the reliability and performance of multisensor mine detection systems.

[2] The New York Times Magazine, "One Leg One Life at a Time" by Donovan Webster, Jan. 23, 1994. Donovan Webster, *Cleaning up a Century of World War*, to be published by Pantheon.

In dry soil, the system can detect buried objects to a depth of 30 cm and more.[3]

New techniques look at the characteristics of disturbed earth. There are two different approaches. When a mine is emplaced, the disturbed earth covering has a different thermal diffusivity than the undisturbed earth. Thus an IR sensor may detect a small difference in temperature between the mine site and the surrounding environment. Unfortunately, nearby clutter could provide a false signal. Another approach has to do with the crystalline conformation of the silica that has been disturbed. Hyperspectral imaging using certain IR bands provide a clear signal that differs from the adjacent undisturbed environment.

Mine clearing, when mines have been located, can be done in several ways. The traditional but very hazardous approach is to use wooden probes to uncover the mine and then either remove it, or with additional explosives detonate it in place. The U.S. military uses a line charge or explosive (MATCHLOCK) fired out by a small rocket that may clear a narrow path. However, because of the new "bladder" mines it is not very effective. Another approach known as Distributed Explosive Mine Neutralization System (DEMNS) uses rockets to extend a large net of primacord. At each node of this primacord net is a small shaped charge that penetrates approximately 10 inches of soil. However, if the net is dropped on some object above the ground's surface, the shaped charge penetration power is greatly diminished because of the longer stand off. Attempts have been made to use various fuel-air explosives to explode a large area of mines. To date, however, these have not delivered sufficient overpressure to detonate the mines.

There are several mechanical means for clearing mines. These involve heavily armored bulldozers with special digging or raking blades in front to clear mines. A variation of this is a helicopter sweeping system towed by a 1,000 foot tow line and resembling a harrow with additional patented digging units.

Yet another approach is biodegration. Assuming there is no time urgency, and the environmental conditions are right, bio-organisms can degrade explosives to inert materials. Another approach, depending on the availability of a large water supply, is to conduct modern hydraulic mining using very high pressure water jets to sweep an area. Others have attempted to detonate the mines in place with high power electromagnetic pulses with some success

The major issue still remains locating the mines once they are emplaced.

NON-LETHAL WEAPONS

The issue of what constitutes a non-lethal weapon is somewhat fuzzy. The definitions presented by Ing. Gen. Carayol of DRET (France) to the AC1243-DS/62 working group will be useful to set the stage.[4] These are:

- Weapons that do not produce long-term aftereffects and are not fatal for 99 percent of combatants and civilians under normal physical conditions.
- Weapons that disrupt, destroy or otherwise degrade the functioning of threat material or personnel, without crossing the "death barrier."
- Instruments used in combat that are designed to achieve the same tactical and strategic ends as lethal weapons, but are not intended to kill personnel or inflict catastrophic damage on equipment.
- Discriminate weapons that are explicitly designed and employed to incapacitate personnel or material, while minimizing fatalities and undesired damage to property and the environment.

[3] S.G. Azevedo, et al, "Micropower Impulse Radar (MIR) Technology Applied to Mine Detection and Imaging." Lawrence Livermore National Laboratory, report UCID-ID-5366, March 1995.

[4] Ing. Gen. Carayol, "Non-Lethal Weapons," AC/243-DS/62, March 1995 meeting item.

NLWs are really a manifestation of the Sun Tzu dictum, "The Sheathed Sword" from the *Art of War*.[5] This refers to supreme excellence in war defined as breaking the enemy's resistance without fighting. In most recent conflicts, such as the Gulf War, it has come to mean achieving military goals with minimal collateral damage, specifically to innocent civilian population. It infers that a non-lethal weapon is the preferred first response in that it achieves the military goal of subduing the enemy threat, and is both morally and politically acceptable. Somehow, it is also implied that avoidance of enemy casualties would result in avoidance of peacekeeping losses.

There are many forms of NLWs and there are several ways to catalog them. In his summary of "New Applications of Non-Lethal and Less Lethal Technology," Richard Garwin has followed a categorization used in the U.S. Army Training and Doctrine Command (TRADOC) publication, "Operations Concept for Disabling Measures" (draft) of September 1992.[6] My approach is somewhat different and hierarchical and follows this outline:

- Planning
- Intimidate/Persuade
- Perception/Reality of Invincibility
- Immobilize Engines of War
- Remove Infrastructure
- Neutralize Personnel

PLANNING

This refers to conflict simulations carried out to assess the effects of any of the proposed NLW technologies before implementation, but also to establish tactics and rehearse missions. The simulations rely heavily on intelligence data gathered from sensors. (See sensors section above.)

INTIMIDATE/PERSUADE

This has all the vestiges of psychological warfare focused on lowering the determination to fight. In the past this has included loud music and pamphlets. A modern approach might include holographic images keyed to loud speakers with a message from a leader who encourages abandoning the fight.

PERCEPTION/REALITY OF INVINCIBILITY

These are generally technologies dealing with survivability. They might include significantly enhanced body armor and armored vehicles or possess active defense capabilities. The latter means sensing an attacking missile, projectile or any other threat and countering it before it strikes. Another approach is to make certain a second shot is not fired. For example, in response to concerns about sniper fire and territorials with mortar tubes on the back of pickup trucks firing on peacekeeping troops in Somalia, we developed a counter sniper detection technology called Lifeguard. The key components are a sensor that identifies a speeding bullet or projectile via its unique signals and a sophisticated computer that processes the signals into an image. When a bullet/projectile is fired, Lifeguard's sensor picks up the location of the projectile and instantly re-creates its flight path, showing on a video screen the path all the way back to its source. The location of the gunman is quickly determined for subsequent action/response.

Further evolution of this concept is to use this technology to detect mortar and artillery shells in flight and to fire a guided hyper-accurate munition to intercept and destroy the shell in flight (hitting a bullet with a bullet). Another approach is to develop a missile with a 5 cm circular error of probability (CEP) at 2 km range so that it will fly down the barrel of a tank gun or artillery piece. Further, some of the RPVs discussed in the sensor section could also carry hyper-accu-

[5] Sun Tzu, *The Art of War*, Edited by James Clavell, Dell Publishing, 1983.

[6] Richard L. Garwin, *New Applications of Non-Lethal and 'Less Lethal' Technology*, American Assembly Book/Conference on U.S. Intervention in the Post-Cold War World: New Challenges and New Resources, April 7–10, 1994.

rate new munitions. These latter concepts would have low collateral damage.

IMMOBILIZING ENGINES OF WAR

There are a large number of possible "soft kill" or "mission kill" approaches to stopping engines of war such as tanks and armored personnel carriers. These include: high strength fibers as entanglements; heat shrink plastic shrouds; submicron pyrophoric dust that would burn out the filters and ignite the fuel, or encapsulated "popcorn" adhesive foam that would clog the heat exchanger and cause the engine to blow; carbon or metal fibers to short out electrical systems of engines; lasers to blind electro-optical systems and windows; high power microwaves to upset or burn out electronic systems controlling the engines; and anti-material chemicals that could cause liquid metal embrittlement or cause elastomeric materials to decompose or lose their mechanical properties.

REMOVE INFRASTRUCTURE

These include using fine-cut carbon or metal fibers to short out electrical systems; trailing a wire from an RPV to short out overhead electrical wires and disrupt communications; using high power microwaves to similarly disrupt electrical power and communication systems including C3I facilities; and utilization of various weapons to disrupt normal operation of airfields, roads and bridges.

NEUTRALIZE PERSONNEL/TEMPORARY INCAPACITATION OF COMBATANTS

Technologies that can cause temporary dysfunction of combatants are numerous and each has a special medical, political, or practical aspect.

For example, the use of a laser for dazzling or blinding is generally regarded as inappropriate and inhumane in that it can cause permanent blindness. The use of calamatives/anesthetics, such as fentanyls, is an issue due to the uncertainty of individual dose response and concerns about chemical warfare, although it can be argued that peacekeeping is like police actions and not war. Low frequency, high amplitude acoustics can cause a wide variety of human dysfunction that, it is said, clears up soon after the acoustics are stopped. Various chemicals can be used to provide an extremely sticky surface for difficult movement or an extremely slick surface causing loss of traction. More effective, rubber bullets or "educated bean bags" that deliver the same stopping momentum up close or at a distance have been demonstrated. The use of multicolor strobe lights can cause significant disorientation while peacekeeping troops are protected with appropriate goggles.

SUMMARY OF NON-LETHAL WEAPONS

The advantage of NLWs is that they can more readily be used in situations where use of traditional force would be ill-tolerated by public opinion. Their value is directly dependent on public opinion. One may, therefore, expect that hostile propaganda will endeavor to exploit any circumstance where their moral acceptability could be faulted and, what is more, to use this to try to discredit the entire NLW concept.

Many of the most easily conceivable NLWs are likely to draw on technologies similar to those prohibited by international regulations or likely to cause public reprobation. This applies to chemical and biological agents and, to some extent, lasers operating in the visible spectrum. The legal issues raised are summarized below.

Biological anti-personnel agents are strictly forbidden, however, anti-material biological agents are authorized. Their use as NLWs is, of course, likely to be the subject of hostile propaganda. It is not certain that there is a very high risk of this, insofar as members of the public are aware of cases where such agents have been used without danger (e.g., to clear up oil pollution).

The treaty banning anti-personnel chemical agents contains an ambiguity that leaves open the possibility of considering them as NLWs. According to the convention, riot control agents are banned only as weapons of war. One possible interpretation of the convention is that such means (i.e., momentary physical incapacitators, sensory irritants, tranquilizers and sedatives) would be conceivable in peacekeeping operations.

International action is underway, at the instigation of Sweden and the Red Cross, to prohibit or regulate the use of anti-personnel lasers. One essential question that arises in this context is that of the possibility of establishing a clear boundary between lasers producing permanent effects (blinding) and lasers producing only a transient effect (dazzle).

The advantages of NLWs are clear enough, so we do not need to dwell on them. We shall simply mention here that they are likely to have a number of unwanted side effects.

- Use of force becomes more acceptable.
- Use may lack decisive action and be perceived as failing to punish the aggressor.
- Use may heighten the resolve of the enemy to respond with lethal force.
- Ease of proliferation.
- May result in quickly developing countermeasures by the enemy.
- May be used against peacekeeping forces and therefore necessitates developing counter-countermeasures.

The very virtue of NLWs may constitute an argument against them, even from a moral point of view, in a comparison with lethal weapons. One can turn this around and say that lethal weapons also derive certain virtues from their inherent excess; they delay the moment of recourse to force and, even in the eyes of the public, may constitute a more appropriate response than NLWs to particularly unpopular criminal acts.[7]

Another concern is the risk of a rapid escalation toward a traditional lethal exchange simply from the initial use of non-lethal means. It is easy to conceive of such a process resulting either by mistake from the adversary or deliberately because he has no means of response other than the traditional one. Incidentally, this leads to the universally accepted conclusion that use of NLWs must always be backed up by conventional superiority. But this essential precaution does not resolve the difficulty raised, namely that eminently humanitarian initial intentions may lead to a distorted response. The need for protection and counter-countermeasures to NLWs is self-evident.

Two categories of NLWs hold the most promise, the first is High Power Microwave (HPM) systems that can be delivered in missiles or projectiles to the targets. These would be driven by the new generation of capacitors and thus there would be no blast or fragments causing collateral damage from explosively driven magnetic flux generators. These HPM systems may have the greatest versatility in terms of upsetting a large spectrum of targets.

These HPM weapons have also been the focus of several studies. Their effects on material are achieved by “front door” coupling of radar antennae, countermeasure systems, communications systems and IFF systems, and also by “back door” coupling via structural defects in the target systems (openings, connections, drivers’ windows, etc.). Their effects may range from disruption (sometimes long-term) to destruction essentially by thermal effects on electronic components.

The utility of HPM weapons has always been limited by the confidentiality of information on the vulnerability of the target systems and secondly by the scale of the development work required on microwave emitter systems.

It is conceivable that these barriers might be partly lifted in the specific context of weapons for peacekeeping. In that case, the target systems could be commercially available systems (cars and communications equipment) with limited hardening, and not subject to the confidentiality constraints of defense equipment.

Reference has been made to the possibility of microwave emissions acting directly on the auditory system, thereby permitting transmission of

[7] Harvey M. Sapolsky, “Non-Lethal Warfare Technologies: Opportunities and Problems,” Report based on a conference held June 2-3, 1993, in Lexington, MA, published by Defense and Arms Control Studies Program, MIT.

messages. It is not clear that this effect can be usefully exploited in practice. The open literature also contains references to the possibility of disrupting the central nervous system at low energy levels. This effect could obviously be important for NLWs if it were confirmed.

Another area of fruitful application for peacekeeping is in the area of acoustics, specifically infrasound. The possibility of causing various incapacitating effects on man (e.g., nausea and loss of balance) by means of frequencies in the range of 100 Hz and below is mentioned in the open literature.

Independent of the question of their effects, two arguments against infrasound systems should be mentioned; first the non-directionality problem and secondly the inefficiency of coupling between the emitting elements and the atmosphere. However, the advent of aerogels can greatly enhance the efficiency of coupling.

Another area is that of anti-material warfare. The following types of generic products have appeared in various U.S. publications:

- super-adhesives—high friction;
- super-slippery products—low friction;
- fast forming foams;
- super acids and super caustics;
- obscurants (smoke and opaque or diffusing layers deposited on the windows of optical systems);
- liquid metal embrittlers;
- combustion inhibitors;
- tire/elastomer attacking products.

Creating many of these substances is not a problem, insofar as the basic technical information about them is commonly known and as some of them have already given rise to illustrative products. This category includes the adhesives, foams, slippery substances, products attacking tires and elastomers and, in the long term, obscurants.

Others are more problematic and may be the subject of relatively advanced research even if some information on them is widely known. Super acids and super caustics are relatively well known in the world of scientific research, but essentially as a means of synthesizing extremely unstable chemicals. Their properties as corrosive agents (e.g., for use against the windows of optical systems, which are the most interesting targets in the NLW context) are not the subject of direct research and cannot be considered to be well known. Similarly, embrittlement of aluminum alloys by liquid metals is a known phenomenon in the scientific world. Mention has been made of the possibility of embrittling an aircraft so that it has time to land before its structures collapse. Finally, inhibitions of combustion engines must be considered a difficult problem for which no solution is yet in sight. One of the major issues affecting the utilization of these anti-material chemicals is the design of delivery devices.

Finally, the area of self-defense or active defense is worthy of further explanation. The ability to track a sniper bullet or territorial mortar or a Bosnian Serb artillery round suggests that there will be instant retribution for hostile acts.

CONCLUSION

There exists a wealth of technology to support peacekeeping operations. An overall architecture is required to effectively utilize these technologies that includes intelligence, situation awareness, reconnaissance, and surveillance; survivability; and a non-lethal force projection to respond to hostile acts.

Among the enabling technologies is a wide spectrum of sensors; mine detection and clearing technologies; and non-lethal weapons. Additional, enabling technologies might include automatic language translators; miniaturized robotic vehicle sentries and scouts; electronic and information warfare; invulnerable mobility; and precision delivery of food, water, and fuel for humanitarian aid.

Remembering the concept of “The Sheathed Sword,” excellence of victory should not inflict nor suffer losses.