2015

Personal Ballistic &
CBRNE Protective Gear Technologies

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1.1   HLS & Public RFID and RFID Security: Market Background

The deployment and use of Radio Frequency Identification (RFID) technology is growing rapidly across many different industries. Developers apply the technology not only in traditional applications such as asset or inventory tracking, but also in security services such as electronic passports and RFID-embedded credit cards. However, RFID technology also raises a number of concerns regarding privacy, homeland security and public safety.

Governments are developing innovative RFID applications in areas ranging from tracking art works and museum stocks to improved airport management and defense applications. Their experience and good practices in developing such applications can benefit other actors and should be shared as widely as possible to maximize the benefits from government investments and help diffusion of the technology.

Governments, in conjunction with business associations, the industry and increasingly with consumer and other citizen groups, have experience in raising awareness of the benefits and challenges of emerging technology applications and their economic and social impacts. Clear and neutral information on RFID technologies, their characteristics and related security and privacy aspects can help small business and the general public appreciate the benefits and risks of these technologies and make informed choices in relation to their use.

On the one hand, there is the potential for benefits in terms of greater accuracy, speed and efficiency when deploying an RFID-enabled system to identify individuals. Newer RFID credentials may also have added benefits of greater fraud prevention and tamper resistance than existing credentials. This would be the likely case in any new credential whether RFID or not, but may be considered a collateral benefit of deploying new credentials. Such new technology may also increase both the cost and complexity of using forged documents. Lastly, there may be benefits in tracking lost identity credentials, such as preventing the casual/opportunistic misuse of the credential. However, it does not address issues related to concerted efforts to falsify credentials.

On the other hand, there are multiple concerns about the use of such systems, including:

- The potential for unauthorized access to the data on the RFID-enabled device, or the data when in transit between the device and reader.

- The selection of RFID-enabled systems for an application if other existing and potentially less privacy-impacting alternatives can achieve the same benefit.

- The concern that the information produced by an RFID-enabled credential system for a stated purpose might be reused or leveraged for a second purpose without the knowledge or consent of those persons whose information was collected for the original purpose.

- The concern that the deployment of RFID-enabled systems represents the potential for widespread surveillance of individuals, including U.S. citizens, without their knowledge or consent.

1.1.1   RFID-based e-ID Personal Documents Markets

The 2008-2018 decade will experience a dramatic growth in the proliferation of RFID-based E-ID personal documents (e.g., E-Passports, E-ID identity cards and E-Driving licenses). With ongoing national programs across the EU, China, India and dozens of other countries, it is forecasted that this market will equip 2.5 Billion people with e-identity documents by 2018, and will create a market of over $250 Billion over the 2009-2018 period.

This market will create business opportunities in the following sectors:

- ❑ Software.

- ❑ I.T. services.

- ❑ Electronic documents manufacturing.

- ❑ Identification Kiosks.

Important Notes:

- ❑ RFID-based e-ID personal documents have other than HLS and Public Safety drivers and benefits (e.g., the 1.3 billion Chinese population e-ID cards will include other data like medical records).

- ❑ Despite the fact that most of the RFID-based e-ID personal documents market was driven by the 9/11 need to "shrink the haystack," since it has other motivations and benefits (e.g., healthcare, law enforcement), only a fraction of this market should be earmarked as HLS and Public Safety-HLD market.

❑ The US lags in this market due to civil rights concerns of the American public.

1.1.2   RFID-Based Systems "Registered Traveler" Programs

Registered Traveler is a program in which frequent travelers voluntarily enroll, in advance, their biometric and personal information in exchange for expedited passage through airport security. TSA would charge a $28 fee to Registered Traveler participants to cover costs of the Registered Traveler programs. This surcharge will cover the registrant's security assessments and managing the Registered Traveler program costs. Furthermore, contractors operating the Registered Traveler programs will charge additional fees for participation.

The Homeland Security Department has sketched the outline of an ambitious plan for internationally sharing biometric identification information about individuals who pose terrorist threats. We forecast that by 2011 more than 5 million business and other air passengers will participate in the "Registered Traveler" program.

The U.S. Homeland Security Department sketched the outline of an ambitious plan for internationally sharing biometric and RFID-based systems identification information about individuals who pose terrorist threats. RFID in "Global Envelope" Program.

This is a DHS proposed program under which the U.S. would begin exchanging information, with its allies, about terrorists. In the first phase, it will exchange biometric and other data with closely allied governments in Europe and Japan. In the second phase, it will progressively extend the program to other countries as a means of limiting terrorists' travel. The DHS stressed its commitment to observing privacy principles during the design and implementation of its biometric systems.

The DHS intends to initiate internationally accepted biometric, RFID-based Systems and IT standards that all national biometric identification systems would use.

It should be noted that each of the 10 privacy laws currently in effect in the United States has an exemption clause for national security purposes.

1.1.3   E-Passport Programs

In a number of countries, traditional paper passports are gradually being replaced with passports embedded with a small integrated circuit. Biometric information, such as face recognition, fingerprints or iris scans are stored in the electronic passport. The electronic passport project was initiated by the US, requesting all countries participating in the Visa Waiver Program issue passports with integrated circuits. The main objectives are for automated identity verification, and for greater border protection and security.

The US-VISIT is a biometrically and RFID-based Systems security measure that begins outside U.S. borders and continues through a visitor's arrival in and departure from the United States. It incorporates eligibility determinations made by the DHS and the Department of State. US-VISIT currently applies to all visitors (with limited exemptions) entering the United States, regardless of country of origin or whether they are traveling on a visa or by air, sea or land. Visitors experience US-VISIT's biometric procedures, finger scans and digital photograph upon entry into the United States.

In those cases where a visitor requires a visa, the Department of State collects the visitor's biometric and RFID embedded biographic information, through the Bio-Visa program, which is then checked against terrorist and criminal watch lists. US-VISIT entry procedures are currently in place at airports and seaports with international arrivals and in the secondary inspection areas of U.S. land border ports of entry.

US-VISIT recently began a test of radio frequency identification (RFID) technology at five land border ports with Canada and Mexico to record the entry and exit of visitors who are required to carry a Form I-94 and enroll in the US-VISIT program.

1.1.4 HLS and Public Safety RFID-Based Systems Supply Chain Markets

RFID tagged cargo appeals to the homeland security community because of the potential to reduce significantly the vulnerability of global inter-modal supply chains to terrorist exploitation. It appeals to supply chain visionaries because of the potential to deliver concrete business benefits, usually via better visibility and control over operations.

Figure 1 - Illustrative RFID and E-Seal Reading in Maritime Supply Chain

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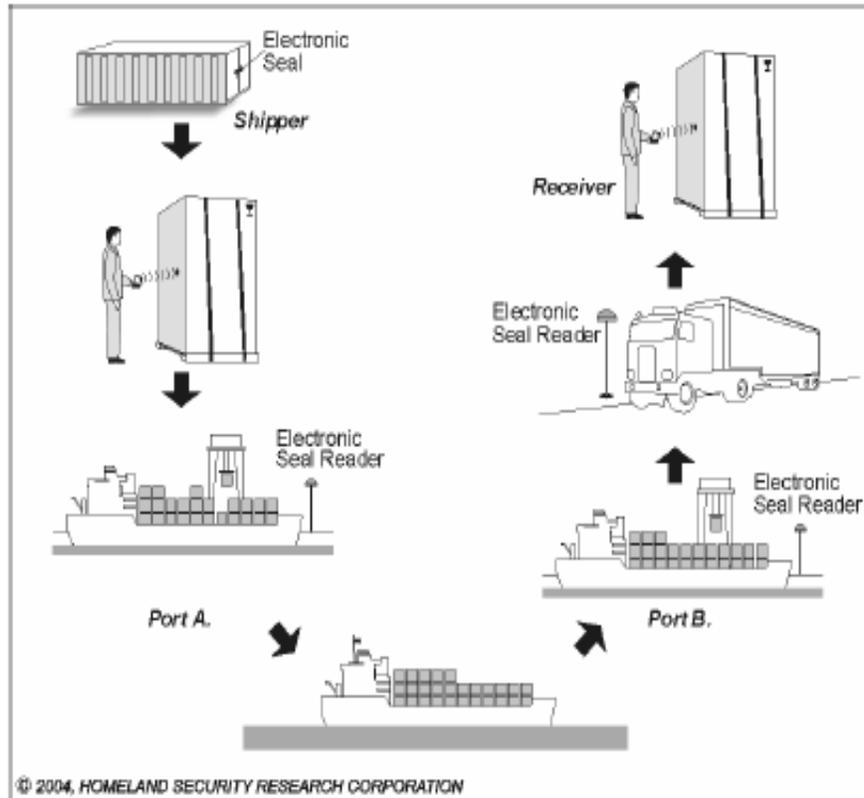
There are three clusters of potential benefits:

1. Shipment and cargo integrity, including theft and smuggling reduction as well as reduced vulnerability to terrorism

2. Operating efficiency, including less wasted effort and more optimal use of people and equipment

3. Operating effectiveness, including greater reliability, more flexibility, and increased customer confidence

We believe RFID tagged cargo is the expression of a clear long-term trend in freight identification and management systems. The trend is reducing the role of human intervention in freight operations and automating the collection of data. Eliminating the human element has proven repeatedly to enhance security, reduce errors, shorten cycle times, and lower costs.

We believe that the security-related ground rules of international trade are unstable, and this has profound implications for the RFID tagged cargo market. Those ground rules are the legal and regulatory framework - multilateral and unilateral - for security, inspections, and the entry of goods.

The positive and negative factors summarized in the following sections will drive, shape, and constrain RFID-tagged cargo development.

❑ The use of non-lethal weapons (NLW) provides a set of moderate options in cases of violent conflicts between the uses of diplomacy and psychological means and the use of lethal force. NLW provides a valuable alternative for law enforcement and military commanders to use less-lethal means between the other options of "Shout and Shoot". Non-lethal weapons provide flexible options to avert violent scenarios by creating time and space, controls level of violence and fill the gap in the options between diplomatic and lethal force.

Figure 2 - Near Term Counter-Personnel NLW

Optical Distractors & Acoustics

Commercial Off-the-Shelf Human Electro-muscular Incapacitation Devices
(**Source**: DOD)

Advanced Materials for Non-lethal Projectiles

NLW have been available for use over the last three decades. Media and political establishment discussions have often focused on the risks and problems associated with NLW technologies. But it is also important to consider its benefits.

The U.S. DoD defines NLW as those means that are "explicitly designed and primarily employed to incapacitate personnel or material while minimizing fatalities, permanent injury and undesired damage to the property and environment."

Figure 3 - Less-Lethal Weapons Clinical Effects
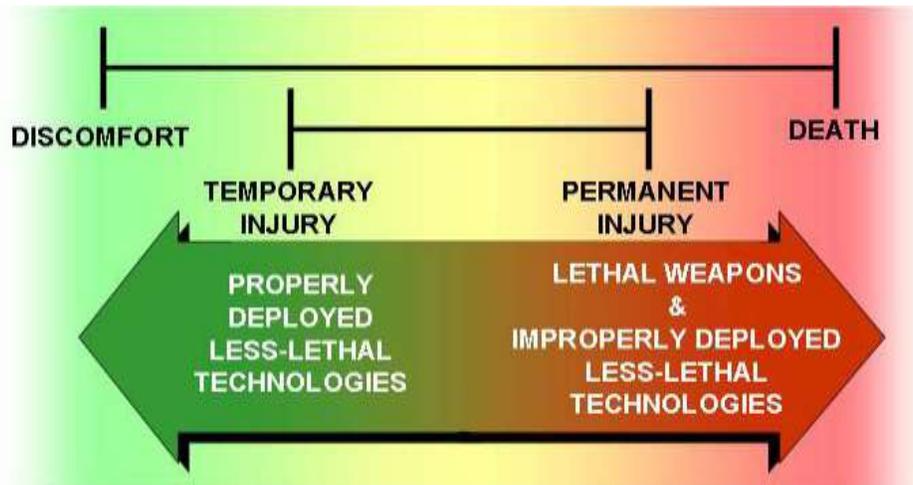
(**Source**: Penn. State University)
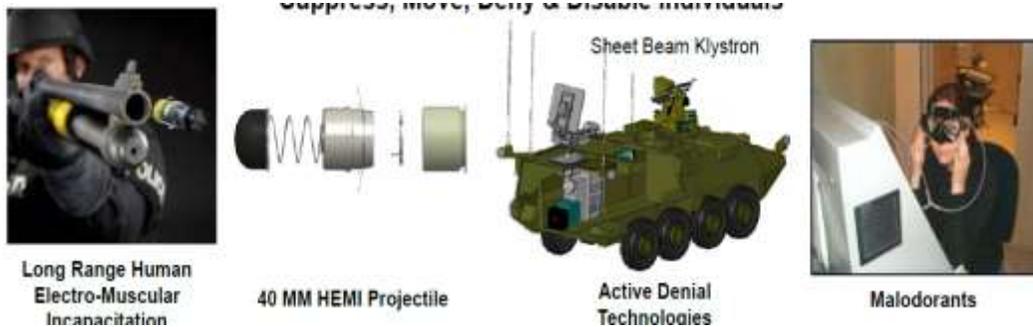
Figure 4 - Mid-Term Counter-Personnel Non-Lethal Weapons

There are three NLW core capabilities and eight functional areas:

- Counter-personnel
- Crowd Control
- Incapacitate Individuals
- Deny Area to People
- Clear and control Facilities/Structures/Areas
- Counter-material
- Area Denial to Vehicles (land, sea, and/or airspace)
- Disable/Neutralize Vehicles, Vessels, Aircraft, and Equipment
- Counter-capability
- Disable/Neutralize threats
- Deny Use of Weapons of Mass Destruction
- NLW technologies are presented in brief in the following figures
- Counter-Personnel NLW Technologies

The following table presents major non-lethal counter-personnel means.

Table 1 - Non-Lethal Weapons Counter-Personnel Means

Means	Description
Infra/Ultra Sound	Sonic generator that projects an acoustic pressure wave to cause discomfort to personnel
Noise	Acoustic generator that produces sufficient sound to disorient or incapacitate personnel
Malodorous Substances	Family of inorganic substances with pungent odors that cause discomfort to personne
Irritants	Substances that cause eye and respiratory irritation/discomfort
Vomiting Agents	Chemicals that cause nausea/vomiting
Optical Munitions	Family of explosive/electric flash devices to stun, dazzle, or temporarily blind.
Strobe Lights	Large, high-intensity stroboscopic light to disorient and confuse personnel
Aqueous Foams	Family of foams that impede mobility and create barriers especially when mixed with irritants
Water Cannon	System that produces a high-pressure stream of water to disable or disburse crowds
Deception	Techniques intended to persuade groups to act against their self-interest.
Non-penetrating Projectiles	Family of projectiles that stuns personnel without penetrating
Super-adhesives, Binding Coatings	Family of adhesives that prevent movement of personnel
Anti-Traction	Family of substances that cause lack of traction for personnel
Entanglers, Containment Devices	Family of nets, meshes and the like to ensnare
Enclosure Fillers	Substance or devices that rapidly fill an enclosed space leaving occupants alive but incapable of movement (e.g., airbags)
Stun Weapons	Family of weapons that subdue or immobilize personnel
Combustible Dispersants	Family of substances that ignite when subject to pressure from personnel passing over
Obscurants	Family of smoke-like agents to obscure observation and disorient
Markers	Family of substances that can be used to covertly mark personnel for later identification. Marking may be overt if so desired
Voice Synthesis Morphing	Device to synthesize the voice or images of a known figure to deceive, produce false orders, or gain access
3-D Holograms	Generator that produces holograms as decoys or deceptions

Figure 5 - Far-Term Counter-Personnel Non-Lethal Weapons

(**Source**: DOD)

Table 2 - Electromagnetic NLW Technologies

Electrical	Radio Frequency	Microwave Frequency	Infrared	Visible Light	Ultraviolet
Direct current	RF devices	High power microwave	Chemical oxygen iodine lasers	Argon Lasers	Laser Ionizer
Pulsed current	Wide/ultra wide band	Millimeter wave	Hydrogen/ deuterium fluoride lasers	Isotopic radiators	
			Solid state lasers	Flashes, flares, and strobes	

Table 3 - Mechanical & Kinetic, Acoustic, Ancillary & Chemical NLW Technologies

Mechanical & Kinetic	Acoustic	Ancillary	Chemical
Blunt Impact Devices	Audible/Optical	Markers	Riot Control Agents
Barriers	Audible	Encapsulates	Foams
Entanglements	Ultrasound	Non-lethal casing	Anti - traction
			Malodorants
			Obscurants
			Nanoparticles
			Thermobarics
			Reactants

1.2   Less-Lethal Weapons: Market Background

❑ In asymmetrical warfare and terror events, adversaries seek to shape conditions to their advantage. Their tactics will try to change the nature of the conflict or use capabilities that they believe are difficult for the blue forces to counter. They will use complex terrain, human shield and populated urban environments and force dispersal methods to offset the advantages of blue forces.

❑ When properly used, non-lethal weapons result in no injuries, fatalities or after effects. When used in military and law enforcement applications, non-lethal weapons are useful in crowd control and riot situations where hostile forces take cover in crowds, in operations in urban terrain, in anti-terrorist actions where they minimize collateral damage, in counter-terror activities, or in hostage situations.

❑ Less-lethal weapons provide police with a wider range of options to choose from in dealing with persons who resist police authority in various situations—in some cases because they have a mental illness or are under the influence of drugs. Each new less-lethal weapon brings its own set of advantages and limitations that must be managed if officers are to choose the best options in a given situation.

❑ Non-lethal means enable a visible demonstration of intent or disruption of war fighting, public violence and crime related law enforcement with minimal casualties and material damage. NLW offers a potentially powerful and flexible coercive tool that can be applicable across a range of military options, crowed control and law enforcement.

❑ Most contemporary armed conflicts are asymmetrical thereby requiring cooperation with combined and joint forces and enmeshing a multitude of NLW and lethal weapons adapted to local, social and cultural differences of the conflict.

❑ NLW have inherent characteristics of precision effects, selectivity of engagement, and versatility. The ability to control weapon effects and minimize violence creates a flexible military capability that can respond across the spectrum of conflict.

❑ Non-lethal options enable intervention at a lower threshold of conflict. Early intervention may reduce the cost of intervention and the risk of escalation. NLWs have utility in major combat operations. In the near future, some non-lethal capabilities may actually exceed those of lethal forces particularly in the area of chemical, biological, and nuclear counter-capability.

❑ Employment of NLW is most effective as part of a synergistic strategy. The non-lethal strategy must be closely coordinated and executed in conjunction with the respective political and economic efforts. The

combined effects produce a powerful, coercive tool to achieve national policy goals without incurring the risks of traditional military actions.

❑ Non-lethal technologies are not usable in all situations. The success of non-lethal technologies is dependent on the specific situation, political goals, and the identified vulnerabilities of the threat.

❑ Multi-billion NLW RDT&E funding driven by the war in Iraq and Afghanistan by the US through the DoD and DOJ failed to meet the techno-tactical NLW needs of the US coalition lead forces.

❑ Most less-lethal weapons adopted during the past ten years by the defense establishment and law enforcement bodies are 'commercially off-the-shelf' (COTS) available products developed in the past by the private sector. For example, the major developers and manufacturers of kinetic launchers and ammunition are companies like Defense Technology Corporation, Combined Tactical Systems (which sells Combined Systems, Inc., products), and Non-lethal Technologies, Inc.

❑ Military personnel are now involved in many operations other than traditional wars. Such operations may require military personnel to perform duties where current military skills and equipment may not be appropriate, e.g. tasks routinely undertaken by police officers. NLW may enable military personnel to take more appropriate action in such situations.

❑ Non-lethal weapons are becoming more widely applicable across the conflict spectrum. This is due to the locus of war shifting from the battlefield to urban areas. The world is becoming more urban. Urban dwellers are forecasted to reach four billion by 2025, or 61 percent of the world population. Moreover, the Armed Forces will be unable to avoid built up areas in maneuver warfare. Urban warfare poses unique problems for less discriminating and catastrophic use of force. Non-lethal weapons will be vital in urban warfare.

❑ There has been an increase in the number of companies that manufacture and trade Non-Lethal equipment; today, approximately 450 companies in 52 countries manufacture NLW systems.

❑ Over the next ten years, the non-lethal weapons market is forecasted to emerge as a key domain for asymmetric warfare and law enforcement technology providers. Governments worldwide have undoubtedly understood the function of non-lethal weapons following lessons learned in Iraq and Afghanistan. Unforeseen street riots and mass demonstrations over the last decade have revealed the loopholes in the security dogma of the 21st century. As a result, many governments have entered into non-lethal weapons RDT&E and NLW procurement dedicated to the full spectrum of public safety, law enforcement, crowd control and asymmetric warfare.

❑ Although some future conflicts may emerge as conventional wars, it is essential that armed forces have an appropriate arsenal of non-lethal weapons available to accomplish their missions. Sending them into such situations armed only with conventional weapons is highly problematic.

❑ The armed conflicts in Iraq and Afghanistan, the turmoil in the Arab world, violent events like the August 2011 UK streets violence and the Israeli-Palestinian conflict drove governments, police and defense decision makers to seek cost-effective NLW means. These decision makers understand that the 21st century "New Media" limits the use of lethal weapons and a new generation of NLW is desperately needed.

❑ Asymmetrical violent conflicts including asymmetrical wars, crowd control and law enforcement require three categories of means to mitigate the conflict. Psychological warfare include diplomatic measures, non-lethal weapons and lethal weapons enmeshing a multitude of new NLW technologies adapted to social and cultural differences.

❑ There is a growing demand from combatant commanders, law enforcement officers and political establishments for NLW capabilities. This demand is driven by the need to help them win the hearts and minds of non-combatant population and prevent world outcry and media attention due to non-combatant casualties.

❑ With regard to military scenarios, the last few years have seen a shift in the use of NLWs from police operations like crowd riot control to military missions such as the protection of fixed military installations and mobile military equipment or the operations themselves. In practice, this means for example, camp or convoy protection or control of checkpoints.

❑ Current non-lethal weapons have been developed to work at ranges typical for crowd riot control situations; the new operational challenges indicate a need for non-lethal capabilities with much longer ranges. Besides this, accuracy and effectiveness at such distances pose a significant challenge.

1.3   Non-Lethal Weapons: HLS & Public Safety Applications

1.4   Non-Lethal Weapons: Business Opportunities & Challenges

The Non-Lethal Weapons industry faces a considerable challenge in seeking to provide the necessary solutions to current and future threats. At the same time, this challenge presents immense opportunities to the Non-Lethal Weapons industries able to deliver effective functions, integrate systems, and maximize security and productivity per $ invested.

Table 4 - Non-Lethal Weapons Market: Business Opportunities

Sector	Market Prospects	Features
Disaster Mitigation	Low	Driven by the need to reduce casualties and disaster ramification costs
CBRN Security	Medium	Driven by the need to provide WMD early warning, protection, and post attack response
Law Enforcement	High	Driven by proven effects of technology on crime mitigation and improved cost-effectiveness of law enforcement agencies
1st Responders	High	Crime and terror are local events where the use of Non-Lethal Weapons systems ameliorates responders' effectiveness
Police Modernization	High	Driven by proven effects of technology on crime mitigation and improved cost-effectiveness of police forces
Maritime Security	High	Driven by the need to safeguard anti-piracy security)
Public Events Security	Medium	Driven by crime threats
Private Sector Commercial & Industrial Security Systems	Low	Driven by proven effects of technology on crime,
Diplomatic Corp. Security	Medium	Driven by terror and violent demonstrations threats

❑ **Terror, crime & natural disasters are here to stay –** The threat of terror crime and natural disasters continues, the vulnerabilities are mostly the same, and the need to protect and militate against the impact and ramification of such events will probably remain constant in the foreseeable future.

❑ **Technological Evolution –** The Homeland Security and Public Safety market is driven by the growing dependence of Homeland Security and Public Safety technologies.

❑ **Costly Asymmetry –** The astronomical number of potential terror-crime targets and the multitude of forecasted terror-crime scenarios requires continuous investment in tremendous amount of resources over a long period.

❑ **The Changing Nature of Anti-Terror Anti-Crime Warfare –** With the nature of the adversary changing and with the need to adopt rapidly to this change, pre-9/11 defense, intelligence, and general security establishments will have to shift major resources from their pre-9/11 agenda to Homeland Security and Public Safety assets.

Figure 6 - Homeland Security and Public Safety
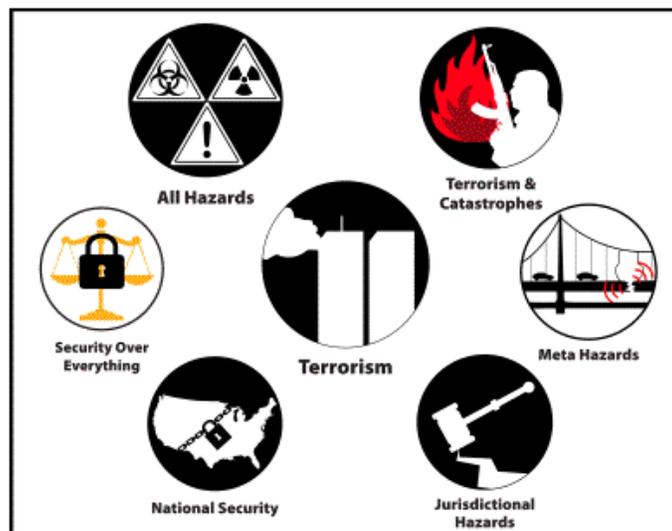
(**Source**: C. Bellavita)

❑ **Public Fear and Public Opinion –** Public opinion and consequently the political establishment rank terror as the #1 threat to national stability. Consistent public opinion polls demonstrate public fears and support the war on terror.

❑ **Political Drivers –** Politicians and economists are very much attuned to the public's fear of terror. The political organizations will do all they can to convey and sustain a sense of security and business as usual.

❑ **Survival of the Protected –** Investment in anti-terror mitigation is not the destiny of western and/or western-leaning countries. Autocratic (non-democratic) regimes need to invest heavily in their regime survival (e.g., Saudi Arabia, PRC).

❑ **Culture of Outsourcing –** The Homeland Security and Public Safety market are increasingly driven by the tendency of most governments and private sector organizations to outsource as much as possible, Homeland Security and Public Safety services and goods to the business community.

❑ **Strategy-less Is Expensive –** The lack of a comprehensive Homeland Security and Public Safety strategy will generate investment in low-priority Homeland Security and Public Safety resources, which will need to be reformed once a comprehensive strategy is in place

❑ **Multiplicity of Responders and Organizations –** Redundant responsibilities and resources by different agencies will result in an extended market.

❑ **Bottom-line –** In spite of the global economic uncertainty, the Homeland Security and Public Safety market is robust and continuingly demonstrative.

❑ **Governments as Main Customer –** Procurement administration of governments in Homeland Security and Public Safety is and will continue to be inefficient at least for the next several years. Anti-terror is also a finite effort - nations cannot spend Homeland Security and Public Safety resources without consideration of the current global economic downturn. National deficits and other non-defense priorities put a cap on Homeland Security and Public Safety expenditures.

❑ **Success Leads to Relaxation –** Paradoxically enough, success in anti-terror measures leads to an increased sense of security, which inevitably results in reduced outlay for anti-terror defense. Unless a new major wave of terror attacks occurs, the Homeland Security and Public Safety infrastructure upgrade process will take 10 to 20 years.

❑ **Lack of In-Depth Understanding of Issues –** The public as well as many of the relevant members of the political community have just a superficial understanding of the risks and consequences of terror. They are largely motivated by immediate fear, sense of current insecurity and need to appease the electorate.

❑ **Economic Inhibitors and National Deficits –** The war against terror is expensive and creates economic and monetary pressures on even the most prosperous economies. Less prosperous economies will find the war on terror to be an unwelcome drain on their already-limited resources. Active mitigation of terror threats may also result in slowing economic activity, due to cross-border screening and other activities that are incompatible with the free flow of goods, services and people. Additional insurance and homeland security burdens might prove more than some

companies – already in economic difficulties – can endure, increasing bankruptcies and inhibiting the starting of new businesses.

❑ **The Socio–Political Environment –** Fighting terrorism requires a long-term commitment, that is sometimes (in the absence of frequent terror attacks) difficult to explain and even more difficult to sustain. Civil societies in democracies are intuitively open and forward-looking, and they find it difficult to reconcile to the inevitable constraints of a war against terror, such as modifications to civil rights statutes. This leads to a strange contradiction: the better a government is at fighting terror, the lesser terror impacts the lives of its citizens; yet, the lesser a population is impacted by terror, the more difficult it is to explain to the constituents the need to invest resources in anti-terror means.

❑ **Limited International Cooperation –** Since terror does not impact every nation equally, and since it is reasonable to assume that nations will have differing ideas about how best to fight terror, it is quite likely that international cooperation in the war against terror will be a struggle of its own. Since the war against terror cannot be won without tight cooperation between disparately different countries, it may very well be the case that such cooperation will have a long establishment and proper maintenance. It is also safe to assume that many countries will be quite reluctant in dedicating resources to support policies and/or actions that they deem unnecessary or even damaging to their own self-interests.

❑ **Ever-changing Legislation and Funding –** Legislation and funding of anti-terror activities is often influenced by local sensitivities and by immediate perception of vulnerability and threat. The allocation of funds toward defending targets of low priority, though of high importance, may be difficult if not impossible. It is also safe to assume that most significant movements towards effective technologies and deployment will be driven by legislation and regulations responding to immediate events (e.g., rail protection bills in the wake of the Madrid bombing; "bio-shield" biological agent mitigation allocations following the Anthrax attacks on Washington, DC)

❑ Some key governments (e.g., EC governments) refrain from aggressive investments in Homeland Security and Public Safety.

❑ The demand for development and deployment of improved capabilities in Homeland Security and Public Safety systems is driving a dynamic and multi-faceted RDT&E sector.

More information can be found at:
Global Homeland Security & Public Safety Market – 2015-2022