Non-Lethal Weapons Capability-Based Analysis

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Abstract

To identify CF‟s non-lethal weapons (NLW) requirements and existing capability gaps, Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA) has conducted a non-lethal weapon capability-based analysis (CBA). This work leverages the analysis conducted under the NATO SAS 078 study in which Canada participated. A set of 18 counter-personnel and eight (8) counter-materiel requirements were identified. Since the CF has only nascent NLW capabilities, the identified gaps were significantly greater that the NATO-wide gaps identified by SAS 078. These gaps can be partially mitigated using ad hoc solutions, and partially by the current and programmed NLW capabilities owned by other NATO militaries.

Résumé

Afin de cerner les besoins des FC en matière d‟armes non létales (ANL) et les lacunes actuelles quant aux capacités, le Centre d‟analyse et de recherche opérationnelle (CARO) de Recherche et développement pour la défense Canada (RDDC) a mené une analyse des capacités liées aux armes non létales. Ce travail met à contribution l‟analyse effectuée dans le cadre de l‟étude SAS 078 de l‟OTAN, à laquelle le Canada a pris part. Une série de 18 besoins antipersonnel et de 8 besoins antimatériel ont été relevés. Étant donné que les capacités des FC en matière d‟ANL ne sont qu‟à l‟état naissant, les lacunes cernées étaient beaucoup plus grandes que celles qui avaient été constatées à la grandeur de l‟OTAN dans l‟analyse SAS 078. Ces lacunes peuvent être atténuées partiellement par l‟emploi de solutions ponctuelles et partiellement par les capacités actuelles et programmées en matière d‟ANL à la disposition d‟autres armées de l‟OTAN.

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Executive summary

Non-Lethal Weapons Capability-Based Analysis

Peter Dobias; DRDC CORA TM 2011-173; DRDC – CORA; October 2011.

Introduction or background:

Canadian Forces (CF) need to be able to conduct full spectrum operations ranging from full scale armed conflict to peacekeeping and emergency response operations domestically and internationally. To identify CF‟s non-lethal weapons (NLW) requirements and existing capability gaps, Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA) has conducted a non-lethal weapon capability-based analysis (CBA). This work leverages the analysis conducted under the NATO SAS 078 study in which Canada participated.

Results:

Using the SAS 078 analysis, the present study identified 18 counter-personnel and eight (8) counter-materiel requirements relevant for the CF. Three of the counter-personnel were further subdivided into three sub-requirements (degrade/stop/disable) each. All of the requirements are in Table below. Currently, the CF has only nascent NLW capabilities, and consequently the identified gaps were significantly greater that the NATO-wide gaps identified by SAS 078 and span almost all of the identified requirements. These gaps can be partially mitigated by procuring some of the versatile current and programmed NLW capabilities owned by other NATO militaries (such as acoustic devices and electro-muscular incapacitators).

Counter-personnel requirements[1]	
CP-WI	Warn individuals
CP-ID	Tag or mark individuals
CP-MI01	Move individuals out of an open area (Land)
CP-MI02	Move individuals out of a confined area (Air/Land/Maritime)
CP-MI03	Move individuals within or out of buildings (Land)
CP-DA01	Deny access to individuals in an open area (Land)
CP-DA02	Deny access to individuals in a confined area (Land/Air/Maritime)
CP-DA03	Deny access to individuals to facilities (Land/Maritime)
CP-DA04	Deny access to individuals on or under water (Maritime)
CP-DI01D	Degrade individuals in an open area (Land/Maritime)
CP-DI01S	Stop individuals in an open area (Land/Maritime)
CP-DI01K	Disable individuals in an open area (Land/Maritime)
CP-DI02D	Degrade individuals in a confined area (Air/Land/Maritime)
CP-DI02S	Stop individuals in a confined area (Air/Land/Maritime)
CP-DI02K	Disable individuals in a confined area (Air/Land/Maritime)
CP-DI03D	Degrade individuals in a building (Land)
CP-DI03S	Stop individuals in a building (Land)
CP-DI03K	Disable individuals in a building (Land)

[1] Yellow denotes partially-met requirements while the red are the requirements not met at all.
[2] Yellow denotes partially-met requirements while the red are the requirements not met at all.

Counter-materiel requirement[2]	
CM-ID	Tag/mark vehicles, vessels, and aircraft in an open or confined area
CM-DA01	Deny access to vehicles in an open or confined area (Land)
CM-DA02	Deny access to surface and submerged vessels in an open or confined area (Maritime)
CM-DA03	Deny the use of landing zones or airfields by aircraft (Land)
CM-DM01	Degrade, stop or disable vehicles in an open or confined area (Land)
CM-DM02	Degrade, stop or disable vessels in an open or confined area (Maritime)
CM-DM03[3]	Degrade or disable weapons (including explosive devices), sensors, and communication equipment (Air/Land/Maritime)
CM-MA	Divert aircraft in the air

Recommendations:

In the view of this analysis, it is recommended that DRDC CORA initiates and coordinates establishment of a CF-wide non-lethal weapons action group that will:

- Revisit the requirements in the view of changing strategic priorities and lessons learned from Haiti and Afghanistan;
- Prioritize requirements and identify which capabilities would be desirable in short (1-10 years) and medium term (10-20 years);
- Establish liaison and active collaborative efforts with allied R&D programs to leverage the expertise of other countries that have more mature NLW programs;

Establish NLW program within Defence R&D community and establish collaboration with industry and academia.

Future plans:

NATO Research and Technology Organization approved SAS 094 study that will support NATO NLW concept of employment development. Canada will participate in the study, and the results will enable further expansion of the Canadian NLW program.

[2] Yellow denotes partially-met requirements while the red are the requirements not met at all.
[3] The requirement is partially met by using optical laser to degrade optical sensors. Thus the capability meets only a very small portion of a potentially very wide requirement

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Non-Lethal Weapons Capability-Based Analysis

Peter Dobias; DRDC CORA TM 2011-173; R & D pour la défense Canada – CARO; Octobre 2011.

Introduction ou contexte:

Les Forces canadiennes (FC) doivent être en mesure de mener les opérations dans l'ensemble du spectre, lesquelles s'étendent du conflit armé total aux opérations de maintien de la paix ou aux interventions d'urgence, au pays ou à l'étranger. Afin de cerner les besoins et les lacunes actuelles des FC quant à leurs capacités en matière d'armes non létales (ANL), le Centre d'analyse et de recherche opérationnelle (CARO) de Recherche et développement pour la défense Canada (RDDC) a mené une analyse des capacités liées aux armes non létales. Ce travail met à contribution l'analyse effectuée dans le cadre de l'étude SAS 078 de l'OTAN, à laquelle le Canada a pris part.

Résultats:

S'inspirant de l'analyse SAS 078, la présente étude a permis de cerner 18 besoins antipersonnel et 8 besoins antimatériel concernant les FC. Trois des besoins antipersonnel ont été subdivisés en trois besoins secondaires (Diminuer les capacités/arrêter/neutraliser) chacun. Tous les besoins sont énumérés au tableau ci-dessous. À l'heure actuelle, les capacités des FC en matière d'ANL ne sont qu'à l'état naissant. Par conséquent, les lacunes cernées étaient beaucoup plus grandes que celles qui avaient été constatées à la grandeur de l'OTAN dans l'analyse SAS 078 et englobaient presque tous les besoins recensés. Ces lacunes peuvent être partiellement atténuées en recourant à certaines des capacités actuelles ou programmées à la disposition d'autres armées de l'OTAN en matière d'ANL (p. ex. des appareils acoustiques ou des incapacitants électromusculaires).

Recommandations

Compte tenu de l'analyse, on recommande que RDDC CARO entreprenne et coordonne la mise sur pied d'un groupe d'action sur les armes non létales à l'échelle des FC qui :

- Révisera les besoins en fonction de l'évolution des priorités stratégiques et des leçons retenues en Haïti et en Afghanistan;
- Établira l'ordre de priorité des besoins et déterminera les capacités qui seraient souhaitables à court terme (1 à 10 ans) et à moyen terme (10 à 20 ans);
- Établira des liens et une collaboration active relativement à des programmes de R. et D. des alliés pour tirer parti du savoir-faire de pays dont les programmes d'ANL sont plus avancés.

Mettra sur pied un programme d'ANL avec la communauté de la R. et D. en matière de défense et instaurera une collaboration avec l'industrie et le monde universitaire.

Besoins antipersonnel[4]	
CP-WI	Avertir des personnes
CP-ID	Étiqueter ou marquer des personnes
CP-MI01	Sortir des personnes d'une zone ouverte (Terre)
CP-MI02	Sortir des personnes d'une zone confinée (Air/Terre/Mer)
CP-MI03	Déplacer des personnes à l'intérieure de bâtiments ou les en sortir (Terre)
CP-DA01	Interdire l'accès à des personnes dans une zone ouverte (Terre)
CP-DA02	Interdire l'accès à des personnes dans une zone confinée (Terre/Air/Mer)
CP-DA03	Interdire à des personnes l'accès à des installations (Terre/Mer)
CP-DA04	Interdire l'accès à des personnes sur ou sous l'eau (Mer)
CP-DI01D	Diminuer les capacités de personnes dans une zone ouverte (Terre/Mer)
CP-DI01S	Arrêter des personnes dans une zone ouverte (Terre/Mer)
CP-DI01K	Neutraliser des personnes dans une zone ouverte (Terre/Mer)
CP-DI02D	Diminuer les capacités des personnes dans une zone confinée (Air/Terre/Mer)
CP-DI02S	Arrêter des personnes dans une zone confinée (Air/Terre/Mer)
CP-DI02K	Neutraliser des personnes dans une zone confinée (Air/Terre/Mer)
CP-DI03D	Diminuer les capacités des personnes dans un bâtiment (Terre)
CP-DI03S	Arrêter des personnes dans un bâtiment (Terre)
CP-DI03K	Neutraliser des personnes dans un bâtiment (Terre)

Besoins antimatériel[5]	
CM-ID	Étiqueter/marquer des véhicules, des navires et des aéronefs dans une zone ouverte ou confinée
CM-DA01	Interdire l'accès à des véhicules dans une zone ouverte ou confinée (Terre)
CM-DA02	Interdire l'accès à des navires de surface ou submergés dans une zone ouverte ou confinée (Mer)
CM-DA03	Interdire à des aéronefs d'utiliser des zones d'atterrissage ou des terrains d'aviation (Terre)
CM-DM01	Diminuer les capacités des véhicules, les arrêter ou les neutraliser dans une zone ouverte ou confinée (Terre)
CM-DM02	Diminuer les capacités des navires, les arrêter ou les neutraliser dans une zone ouverte ou confinée (Mer)
CM-DM03[6]	Diminuer les capacités des armes (y compris des engins explosifs), des capteurs ou du matériel de communication ou les neutraliser (Air/Terre/Mer)
CM-MA	Détourner un aéronef en vol

Plans d'avenir

L'Organisation pour la recherche et la technologie de l'OTAN a approuvé l'étude SAS 094, qui favorisera l'élaboration du concept d'emploi des ANL de l'OTAN. Le Canada prendra part à l'étude, et les résultats permettront de développer le programme d'ANL du Canada.

[4] En jaune, les besoins partiellement comblés; en rouge, les besoins qui ne sont pas comblés du tout.
[5] En jaune, les besoins partiellement comblés; en rouge, les besoins qui ne sont pas comblés du tout.
[6] Ce besoin est partiellement comblé grâce à l'utilisation d'un laser optique pour réduire la capacité de capteurs optiques. Par conséquent, la capacité ne répond qu'à une infime partie d'un besoin qui peut se révéler très grand.

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1 Introduction

1.1 Background

Present-day conflicts often take place in the vicinity of non-combatants. At the same time, civilian casualties are under increased scrutiny. Consequently, there is a growing requirement to fill in the space between verbal warnings and the use of lethal force. Non-lethal weapons (NLW) are gaining more and more pre-eminence since they provide armed forces with an ability to apply force without permanent consequences. This decreases the likelihood of unwanted injury or death.

North Atlantic Treaty Organization (NATO) developed a serious interest in non-lethal weapons in the late-1990s, following their effective use in a U.S. operation that facilitated the safe withdrawal of UN forces from Somalia. In 1999, the North Atlantic Council identified NLW as "a critical additional capability needed in order to meet the demands of future operations". The Council also formally approved a NATO NLW Policy [1], which offers the following definition:

> *"Non-Lethal Weapons are weapons which are explicitly designed and developed to incapacitate or repel personnel, with a low probability of fatality or permanent injury, or to disable equipment, with minimal undesired damage or impact on the environment."*

In 2007-2008, a NATO Army Armaments Group (NAAG) Quick Reaction Team prepared a new NATO NLW Roadmap. One of the central efforts called for in the Roadmap was a NLW Capabilities-Based Assessment. In 2008 the Systems Analysis and Studies (SAS) Panel approved, and the Research and Technology Board endorsed, the establishment of SAS 078, "Non-Lethal Weapons Capability-Based Analysis" The purpose of SAS 078 was to determine alliance and national NLW requirements, assess current and projected capabilities versus requirements to identify capability gaps, identify candidate solutions (non-materiel and materiel), perform associated work on experimentation, and offer study conclusions and recommendations [2]. The author of the present report was the Canadian representative for SAS 078, and the present report on the CF CLW capability leverages this study.

The present study supports the strategic objective for the Canadian Forces (CF) which states that the CF need to be able to conduct full spectrum operations ranging from full scale armed conflict to peacekeeping and emergency response operations domestically and internationally [3]. This is consistent with the NATO strategy that led to the requirement for non-lethal capabilities as outlined above. To identify CF‟s NLW requirements and existing capability gaps, Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA) has conducted a non-lethal weapon capability-based analysis (NLW CBA), the product of which is summarized in this report.

1.2 Objectives

The primary objective of this paper is to identify the CF‟s NLW requirements and corresponding capability gaps. The secondary objective is to outline existing NATO-wide capabilities and propose some solutions and mitigation options for the Canadian gaps.

1.3 Scope

1. The requirements were determined using unclassified strategic scenarios developed by the Chief of Force Development (CFD) [4], NATO NLW vignettes [5], and the existing NATO non-lethal weapons requirements list [6];

2. The gap analysis used existing CF NLW capabilities as obtained from Director of Land Requirement (DLR) documents [7];

3. The solution analysis looked at NLW capabilities available for other NATO militaries, NLWs used by other security agencies and non-NATO militaries, and off-the shelf NLW capabilities as identified by the SAS 078 Solution workshop [8].

1.4 Paper Layout

The paper is organized as follows. In Section 2, at first the relevance of the SAS 078 vignettes is established in the context of the CDF scenarios. Then the requirements and corresponding capability gaps and possible mitigation options are identify in the Canadian context. A set of recommendations for further NLW assessment in Canada is in Section 3. The summaries of scenarios and the vignettes are in Annexes A and B respectively, SAS 078 results for the requirements and best corresponding capabilities are in Annex C, the list of current and programmed NATO capabilities as identified by SAS 078 is in Annex D. Finally, the results of the SAS 078 solution analysis are summarized in Annex E.

2 NLW Requirements Analysis

The requirements analysis leverages the results of SAS 078 analysis and puts it in the context of Canadian strategic considerations represented by the set of the unclassified CFD force development scenarios [4] as a benchmark. The scenarios are summarized in Annex A.

In order to identify NATO-wide NLW requirements, SAS 078 study group in collaboration with the NATO Allied Command Transformation (ACT) conducted a requirement workshop that identified 37 possible tactical vignettes covering a wide range of operations that may require use of non-lethal weapons [5]. The tactical SAS 078/ACT vignettes are summarized in Annex B. These 37 vignettes led to 13 counter-personnel and 10 counter-materiel requirements. Three of the counter personnel were composed of three distinct tasks (to degrade, stop, or disable individuals). These were treated as independent requirements for the purposes of this paper. The requirements were endorsed by two NATO commands (ACT and ACO) as formal NATO NLW requirements ([5] and [6]). The detailed list of requirements derived from them and the best capabilities addressing them are summarized in Annex C.

The analysis assumed that the vignettes are a viable possibility within the context of the CFD scenarios. A cross-link identifying which vignettes were plausible for which scenario was established, and then the inverse assessment was conducted in order to identify which vignettes did not correspond to any of the CFD scenarios. The CFD scenarios have been used among other materials in the development of the vignettes that attempted to capture as many relevant force employment scenarios as possible. The mandate of SAS 078 study was to identify all NATO-wide requirements. Therefore it is assumed that there would not be additional requirements than those identified from the set of the vignettes. Once it is established that a particular tactical vignette is plausible for at least one of the CFD scenarios, it is assumed that the requirements identified on the basis of this vignettes are valid requirements for the CF.

2.1 Link between SAS 078 Vignettes and CFD scenarios

In order to utilize the SAS 078 results, it is necessary to establish relevance of the NATO NLW vignettes used by SAS 078 in the context of the CFD scenarios. It was done in two steps. At first, plausible vignettes were assigned to each of the scenarios. Then, to facilitate the identification of relevant requirements, the relevant scenarios were shown for each vignette. The latter enabled simple determination of which vignettes were not relevant in the context of the CFD scenarios.

Table 1 shows there is a viability of a tactical vignettes involving the use of NLW for all but two CFD scenarios. The two scenarios are the rescue operation in Canadian waters that does not assume any use of force, and the full conventional war. The fact that the NLW-related vignettes are plausible for nine out of eleven scenarios highlights the relevance of the NLW for the CF.

Table 1. *Relevant vignettes for each CFD scenario*

CFD Scenario	SAS 078 Vignette
Scenario 1	None
Scenario 2	5
Scenario 3	3,11,13,21,25,28,30-34
Scenario 4	22
Scenario 5	4,6
Scenario 6	35
Scenario 7	1,3,11,12,14,17,19,20,26,27,37
Scenario 8	16
Scenario 9	3,9,13-15,18,26,27,35
Scenario 10	23,24,37
Scenario 11	None

Table 2 shows the reverse correspondence between vignettes and the CFD scenarios. Only five out of 37 vignettes (vignettes 2, 7, 8, 10, and 36) are not viable for any of the scenarios. Thus, if any requirement identified by the SAS 078 group is derived from any of these vignettes alone (i.e. it is not be connected with any other vignette that has a direct correspondence with the CFD scenarios), it will be not be considered a valid CF requirement, and will be discarded.

Table 2. *Cross-reference between Canadian CFD scenarios and SAS 078 vignettes*

SAS 078 Vignette	CFD Scenario	Other comment
Vignette 1: Ambush	7	
Vignette 2: Bio Attack	None directly	Might be relevant for peacekeeping or humanitarian missions
Vignette 3: Helicopter down	3,7,9	Common application: dealing with hostile crowd
Vignette 4: Hostages	5	Common risk for humanitarian assistance missions
Vignette 5: Looting	2	Crowd control
Vignette 6: Non-combatant evacuation	5	Crowd control
Vignette 7: Supertanker threat	None directly	Might be relevant for port protection or during major events in coastal/port areas
Vignette 8: Freight in harbour	None directly	May be relevant in NEO/anti-piracy operations
Vignette 9: Small plane	9	
Vignette 10: Speed boats in harbour	None directly	May be relevant in NEO/anti-piracy operations
Vignette 11: Convoy operations	3,7	
Vignette 12: Elections	7	
Vignette 13: Patrol	3,9	
Vignette 14: Plane crash	6,7,9	
Vignette 15: POW camp	9	Riot control
Vignette 16: Ship boarding	8	
Vignette 17: Warlord arrest	7	
Vignette 18: Camp protection	7,9	
Vignette 19: Checkpoint	7	
Vignette 20: Village search	7	
Vignette 21: Refugee camp	3	Crowd control, arresting violent instigators/criminals
Vignette 22: Drug smuggling	4	
Vignette 23: TV Station	10	
Vignette 24: Divers	10	
Vignette 25: Hi-jacked convoy	3	
Vignette 26: Monastery protection	7,9	
Vignette 27: Convoy escort	3,7,9	
Vignette 28: Ambulance escort	3	
Vignette 29: School bus escort	6	
Vignette 30: Relief supplies	3	Panicking crowd
Vignette 31: Camp riot	3	
Vignette 32: Port protection	3	
Vignette 33: Hospital security	3	
Vignette 34: Hospital security	3	
Vignette 35: Riot at checkpoint	6,9	Crowd control
Vignette 36: Camp riot	None directly	Might be relevant for peacekeeping operations
Vignette 37: Urban Operations	7,10	

Table 3 shows which requirements identified by SAS 078 are connected with the vignettes that had no corresponding CFD scenarios. The numerical codes are the ones used by SAS 078 and are consistent with Annex C. CP stands for counter personnel and CM for counter-materiel requirements. Only one of the requirements (move individuals on or under water) was defined solely on the basis of the vignettes with no correspondence to the CFD scenarios, and will be omitted from the further analysis. As was mentioned earlier, two requirements were identified by the participants at the SAS 078 requirements workshop independently of the vignettes (deny access to surface or submerged vessels and stop aircraft on the ground). The former is related to two of the CFD scenarios 8 and 10 directly and thus will be retained; the latter will be omitted.

In addition, SAS 078 group determined that the scope of the requirement to degrade or disable facilities is too wide and would require CBA of its own, and therefore it was omitted from the analysis. The same thing is being done in this report.

Table 3. *Vignettes without counterpart among the CFD scenarios*

Vignette	Requirements for these vignette alone	Requirements with other vignettes
2,7		CP-DI002 (degrade, stop or disable individuals in confined area)
8		CP-DI002 (degrade, stop or disable individuals in confined area), CP-DA002 (deny confined area)
10	CP-MI004 (move individuals on or under water)	
36		CP-MI003 (move individuals in buildings), CM-DM003 (degrade or disable weapons, sensors and communication devices)
none	CM-DA002[7] (deny access to surface or submerged vessels)	
none	CM-MA001 (stop aircraft on the ground)	

[7] While not directly related to any of the vignettes, this requirement was identified as a very plausible. It can be derived from the CFD scenarios 8 and 10.

2.2 CF NLW Requirements and Capability Gaps

Using the results for the NATO non-lethal capabilities requirements obtained by the SAS 078 study group combined with the cross-referencing of SAS 078 vignettes to the CFD scenarios 18 counter-personnel and eight (8) counter-materiel NLW requirements were obtained. The results are summarized in Table 4 (counter personnel) and Table 5 (counter materiel).

Current Canadian NLW capabilities are very limited. They consist of a crowd confrontation kit (protective equipment, batons and shields), tear (CS) gas (including 40mm Ferret breaching rounds, hand grenade and spray), flash bang grenades, limited number of green laser warning devices (GLWD) and limited selection of blunt trauma rounds for 12 gauge shotgun and 40mm grenade launcher [7]. NATO‟s NLW capabilities are more well developed that those of the CF. For example, some of the key capabilities that exist in NATO, but are absent within the CF include acoustic warning devices such as LRAD, muscular incapacitators, and vehicle nets. The NATO-wide capabilities are listed in Annex D. Since the existing Canadian NLW capabilities are limited, the detailed analysis conducted by SAS 078 was not repeated. The existing Canadian NLW capabilities gaps are summarized for each requirement.

Lastly, some possible mitigation options using the work of SAS 078 are identified for each requirement. Some of the CF‟s gaps capabilities could be readily mitigated using non-lethal capabilities available in other NATO militaries. Additional mitigations could be achieved using systems not designed as non-lethal weapons but providing some non-lethal capabilities [8]. A detailed discussion of additional mitigation options can be found in references [8] and [10] and is summarized in Annex E.

Counter-Personnel Requirements

Below is a list of counter-personnel requirements that have been identified as being relevant for the CF, together with the identified capability gaps. A summary of requirements is in Table 4.

i) *CP-WI: Warn individual*. The CF need to be able of providing warning to maintain stand-off distances, prevent unintended approaches, and help determine target‟s intent. They should be able to selectively target one, few or many static or approaching personnel, either individually or collectively, whether they are protected or unprotected[8]. The desired range is up to 600m, but up to 300m covers most situations. The desired area of effect is 300m in radius. The onset of effect should be immediate and the duration of effect should be several seconds to minutes.

   The only Canadian option to warn individuals is the GLWD. It covers most of the required range, but only allows targeting of a single individual, and does not provide area coverage.

[8] Protection in this context includes using items that are commonly available to civilian population. If the approaching personnel uses military style protection (ballistic protection, etc.) they likely have a hostile intent and the escalation of force might be required.

The best NATO-wide option was the Long-Range Acoustic Device (LRAD) 1000X. To increase the area coverage and to enable individual targeting, a combination of LRAD/optical warning device could be used. Other options include flash bang grenades, smoke, airburst munitions, etc.

ii) *CP-ID: Tag or mark individual*: The CF must be capable of overtly or covertly tagging/marking individuals so that they are identifiable and traceable. They should be able to selectively target one, few, or a group of static or moving personnel, either individually or collectively. The desired range is up to and beyond 600m, but up to 300m covers most situations, and the desired area of effect is 50m in radius. The onset of effect should be immediate, and duration of effect should be at least several hours to a few days.

The CF currently do not have any capability addressing this requirement.

Within NATO, there is a variety of marking rounds containing both visible and ultraviolet (UV) paint. In addition, research work on miniature radiofrequency (RF) tags and GPS tracking devices is being done. Other options include radioactive tagging, use of malodorants, and possibly photography and subsequent facial recognition techniques. Using micro Unmanned Aerial Vehicles (UAV) as a delivery vehicle would increase range beyond the range of small arms rounds.

iii) *CP-MI01: Move individuals out of an open area (Land)*. The CF Forces must be capable of moving and/or channelling individuals who are in the open, out of or through an area. They should be able to selectively target one, few, a crowd or group of static or moving personnel, either individually or collectively, who are unprotected. The desired range is up to and beyond 600m, but up to 100m covers most situations, and the desired area of effect is up to 50m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The CF can use blunt trauma rounds and CS gas. Both options have limited range. CS gas allows for a collective targeting, while the blunt trauma rounds are intended against individual targets.

LRAD (generating intolerably high levels of physiologically intolerable noise) was identified as the best existing capability to address this requirement, surpassing blunt trauma rounds and CS gas. Other possible solutions identified by SAS 078 included the use of water cannons (perhaps including irritant in the water), active denial technology (ADT), sweep LRAD beams, malodorants, etc.

iv) *CP-MI02: Move individuals out of a confined area (Air/Land/Maritime)*. The CF must be capable of moving individuals who are in confined areas (e.g., fenced compound, interior compartment of a vehicle, ship, or airplane) out of those confined areas. They should be able to selectively target one, few, a crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 50m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The CF has both CS gas and blunt trauma rounds available, but both systems are inferior to the systems identified by SAS 078 as the best fit for the requirement (Annex A). The most significant shortfall is in range and coverage. While the requirement is for up to 600m range, the current CF capabilities cover range only up to ~30m.

The NATO capabilities to address this requirement fall to the same broad categories as the Canadian capabilities (tear gas and blunt trauma rounds). However, the systems identified by SAS 078 have performance (in particular the range) superior (yet not sufficient to address requirement) to the existing Canadian capabilities. Possible additional solutions include use of canine, acoustic devices, flash bangs, malodorant, irritant fog, etc.

v) *CP-MI03: Move individuals within or out of buildings (Land)*. The CF must be capable of moving individuals who are in a building out of the building or into other parts of the building. They should be able to selectively target one, a few, a crowd, or a group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 20m covers most situations, and the desired area of effect is up to 200m2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The Canadian Ferret round was identified as the best NATO NLW capability to address this requirement in cases when the use of chemical agents is permissible. On the other hand the CF blunt trauma rounds are inferior to the sting ball system identified by SAS 078 as the best non-chemical solution. Both capabilities are limited with regards to range and area coverage.

The blunt trauma rounds used by Canada are inferior in range to the systems identified by SAS 078; neither of them meets the requirement completely. Some additional options mitigating this gap are ADT, triggering sprinklers in a building, changing temperature, using fogging systems or pheromones to attract small mammals (rats).

vi) *CP-DA01: Deny access to individuals in an open area (Land)*. The CF must be capable of preventing individuals who are on foot or some type of open conveyance, such as a bicycle, from entering or leaving a specific area. They should be able to selectively target one, few, a crowd, or group of moving personnel, either individually or collectively, who are unprotected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 50m radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

The best system that the CF have is the Ferret round, with range only 45m, thus the remaining gap is in range and area coverage.

The best NATO-wide capability (CS gas) has performance superior to Canadian 40mm rounds, but it still does not completely satisfy the requirement. Some identified mitigation options include use of dogs, ADT, combination of multiple

NLWs, physical barriers, high-energy muscular incapacitation (HEMI) barriers, sticky foams, non-lethal Claymores, etc.

vii) *CP-DA02: Deny access to individuals in a confined area (Land/Air/Maritime)*. The CF Forces must be capable of acting against individuals in a confined area, such as a room in a building, a fenced compound, or an interior compartment of a vehicle, and preventing them from entering or leaving that area or entering another confined area within the same vicinity. They should be able to selectively target one, few, a crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 15m radius. The onset of effect should be immediate, and duration of effect should be up to few hours.

The CF limitations are the same as for CP-DA01 (above); the same applies for the mitigation options.

viii) *CP-DA03: Deny access to individuals to facilities (Land/Maritime)*. The CF must be capable of preventing individuals from entering into facilities (land and sea-based) by denying the use of access/entry points. They should be able to selectively target the approaches and access points, either individually or collectively. The desired range is up to 100m, and the desired area of effect is up to 10m radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

There are no available capabilities satisfying this requirement NATO-wide. This requirement was eliminated from the SAS 078 solution analysis since it was determined that it would merit separate CBA due to complexities involved.

ix) *CP-DA04: Deny access to individuals on or under water (Maritime)*. The CF must be capable of preventing individuals who are on or underwater (e.g., swimmer or SCUBA diver) from entering or leaving a specific area. They should be able to selectively target one or few moving personnel, either individually or collectively, who are unprotected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

The CF has no capability addressing this requirement.

Several NATO countries field underwater acoustic device (eLoud) that provides some mitigation of this requirement. A combination of underwater and surface acoustic devices (eLoud + LRAD) would provide coverage both under water and on the surface. Other proposed mitigation options include pulse and vortex guns, percussion grenades, bubble streams, marine mammals, etc.

x) *CP-DI01D: Degrade individuals in an open area (Land/Maritime)*. The CF must be capable of decreasing the physical functionality of individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but

up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The CF have the acoustic flash bang grenade available. It does not provide sufficient range, coverage or duration.

The NATO-wide capabilities fall into categories available to the CF; however, the best capabilities, while not meeting the requirement completely, still surpass those available to the CF. Some solutions identified by SAS 078 included ADT, lasers, or improved CS gas delivery. Airburst and/or UAV or unmanned ground vehicle (UGV) delivery systems could be used to extend range.

xi) *CP-DI01S: Stop individuals in an open area (Land/Maritime)*. The CF must be capable stopping individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 5 minutes.

The CF can use CS gas or blunt trauma round. None of these solutions provides sufficient range or area coverage.

The mitigation options identified by SAS 078 are the same as for CP-DI01S (above).

xii) *CP-DI01K: Disable individuals in an open area (Land/Maritime)*. The CF must be capable of disabling individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to five (5) minutes.

The CF have no capability to disable (physiological, involuntary rather than psychological response) a person using non-lethal means.

Currently the best available option of inducing involuntary incapacitation of an individual (not dependent on compliance) is HEMI. Widely-used Taser X26E does not provide sufficient range, but a multiple options with different delivery increasing range will become available in the near future. Sleeping agents were mentioned by the participants at the SAS 078/ACT solution workshop; these might not be possible due to treaty restrictions. Other options include use of dogs, nets, sticky foam, hollow-fibre obstacles, etc.

xiii) *CP-DI02D/S/K: Degrade/Stop/Disable individuals in a confined area (Air/Land/Maritime)*. The CF must be capable of decreasing the physical functionality of individuals/stop/disable individuals who are in a confined area to a

level that they cannot perform their intended action. They should be able to selectively target one, few, crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The same limitation and mitigation options as for CP-DI01D/S/K apply.

xiv) *CP-DI03D/S: Degrade/Stop individuals in a building (Land)*. The CF must be capable of decreasing the physical functionality of or stop individuals who are in a building to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 200 m^2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

The best capability identified by SAS 078 is the flash bang grenade. However, this capability does not provide sufficient range, coverage or duration.

The best NATO-wide capability addressing this requirement is a flash bang, lacking range, area coverage and duration. Possible other solutions would include welding doors/access points, barriers, or using irritants. Some of the mitigations for CP-DI01D and CP-DI01S might apply as well.

xv) *CP-DI03K: Disable individuals in a building (Land)*. The CF must be capable of disabling individuals who are in a building to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 200m^2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Apart from the chemical agent solution (CS gas) the CF do not have a capability to meet this requirement. SAS 078 group determined that the CS gas would be able to disable personnel in a building due to high concentration and slow dispersion. However, in many scenarios use of the CS gas might not be permissible. In addition, the delayed effect might render it ineffective.

The best capabilities addressing this requirement are CS gas (available to the CF), and Taser. However, both lack range and area coverage. Other options would include extended range HEMI (same comments as for CP-DI01K apply).

Counter-Materiel Requirements

Below is a list of counter-materiel requirements that have been identified as being relevant for the CF, together with the identified capability gaps. A summary of requirements is in Table 5.

xvi) *CM-ID: Tag/mark vehicles, vessels, and aircraft in an open or confined area*. The CF must be capable of overtly or covertly tagging/marking vehicles, vessels or aircraft, so that they are identifiable and/or traceable. They should be able to selectively target one, few, or a group of static or moving vehicles, either individually or collectively. Desired range is up to and beyond 600m, but up to 600m covers most situations, and desired area of effect is 10m in radius. A short delay in onset is acceptable, and duration of effect should be at least several hours to 12 months.

The CF do not currently have any capability addressing this requirement.

As for CP-ID, many NATO countries own paint rounds. In addition, there are emerging RF technologies that would enable improved overt/covert tracking and identification capabilities. Other proposed solutions included embedding RF chips into vehicles/vessels during manufacturing process and use of Special Forces to add tracking devices to vessels/vehicles of interest.

xvii) *CM-DA01: Deny access to vehicles in an open or confined area (Land)*. The CF must be capable of restricting movement of suspicious or potentially threatening vehicles in NATO controlled or uncontrolled areas. They should be able to selectively target one, few, or groups of moving vehicles, either individually or collectively. Target vehicles may be moving at up to 100 kph and may weigh up to 30 tons. Desired range is up to 1000m depending on the size and speed of the vehicle, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 10 minutes.

The CF do not currently have any capability addressing this requirement.

Currently, spiked nets are in use by several NATO militaries, and remote delivery platforms are being explored. There were a number of additional solutions identified at the SAS 078/ACT solution workshop, including RF and high-powered microwave (HPM) vehicle engine stoppers, combustion modifiers, use of barriers, temporary obstacles such as old vehicles and animals, balloons, nets, anti-vehicle non-lethal mines, slippery coating, dazzlers, air turbulence generators, strong lights, spray paints, etc. These solutions apply to all of *CM-DA* and *CM-DM* requirements.

xviii) *CM-DA02: Deny access to surface and submerged vessels in an open or confined area (Maritime)*. The CF must be capable of influencing movement of suspicious or potentially threatening surface or submerged vessels. They should be able to selectively target one, few, or groups of moving vessels, either individually or collectively. Target vessels may be moving at up to 75 kph and may be any type of vessel. Desired range is up to and beyond 600m, but up to 1000m covers most

situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 10 minutes.

The CF do not currently have any capability addressing this requirement.

There are no current capabilities meeting this requirement. Same solutions as for CM-DA01 apply.

xix) *CM-DA03: Deny the use of landing zones or airfields by aircraft (Land)*. The CF must be capable of restricting aircraft use of airfields and landing zones in NATO controlled or uncontrolled areas to deter illegal activity, covert actions, and enforce sanctions. They should be able to selectively target landing zones and airfields. Desired range is up to and beyond 600m and desired area of effect is 20m by 50m. Onset of effect should be immediate, and duration of effect should be at least 24 hours (adjustable duration is preferred).

The CF do not currently have any capability addressing this requirement.

There are no current capabilities meeting this requirement. Same solutions as for CM-DA01 apply.

xx) *CM-DM01: Degrade, stop or disable vehicles in an open or confined area (Land)*. The CF must be capable of decreasing the performance or completely limiting the functions of suspect vehicles to prevent adversary use as escape or attack vehicles. They should be able to selectively target one, few, or groups of static or moving vehicles, either individually or collectively. Target vehicles may be static or moving at up to 100 kph and may weigh up to 30 tons. Desired range is up to 1000m depending on the size and speed of the vehicle, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 60 minutes.

The CF do not currently have any capability addressing this requirement.

Multiple NATO countries are currently fielding caltrops and Spiked Xnets. There are remote delivery mechanisms being developed to increase the range of the capability. Additional solutions for this these requirements were identical with CM-DA01.

xxi) *CM-DM02: Degrade, stop or disable vessels in an open or confined area (Maritime)*. The CF must be capable of stopping or decreasing the performance or completely limiting the functions of surface or submerged vessels. They should be able to selectively target one, few, or groups of static or moving vessels, either individually or collectively. Target vessels may be moving at up to 75 kph and may be any type of vessel. Desired range is up to 1000m. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least a few hours.

The CF do not currently have any capability addressing this requirement.

Shoulder-launched propeller entanglement devices can be used to stop or degrade performance of small, propeller-driven vessels. Additional capabilities include combustion modifiers, RF and HPM engine stoppers, etc. There are no capabilities that would be applicable to large cargo vessels.

xxii) *CM-DM03: Degrade or disable weapons (including explosive devices), sensors, and communication equipment (Air/Land/Maritime)*. The CF must be capable of decreasing the performance or completely limiting the functions of weapons (including explosive devices), sensors, and communication equipment. They should be able to selectively target one, few, or groups, either individually or collectively. The target may be static or moving. Desired range is up to and beyond 600m. Desired area of effect depends on the scenario, but 50m in radius was used as a guideline. The onset of effect should be immediate, and duration of effect should be at least a few hours.

The CF can use the GLWD to degrade performance of optical sensors. However, the system does not provide area coverage and has no impact on non-optical systems. The CF do not currently have any capability addressing the requirement to disable sensor or weapon systems.

Proposed solutions include variety of acoustic, optical and electromagnetic sources attacking/saturating respective sensors, microwave heating of weapons, sticky agents, etc. There are acoustic systems that could be used to break detonators in explosive devices.

xxiii) *CM-MA: Divert aircraft in the air*. The CF must be capable of re-directing an aircraft in the air to prevent entry into designated airspace. They should be able to target one aircraft. Target aircraft may be moving (up to 800 kph) and may be any type of aircraft. Desired range is 5000m for high speed aircraft and 1500m for other aircraft. The onset of effect should be immediate, and duration of effect should be up to 30 minutes.

There is no capability NATO-wide addressing this requirement. Some future solutions might include use of hot air balloons, plasma heaters changing airflow over airfoils, use of air turbulence generators, temporary attachment of small drag-increasing devices to wings, etc.

In summary, the CF NLW requirements are largely consistent with the NATO-wide requirements. However, the existing CF capabilities are very nascent, and consequently the CF forces have significant gaps in most of the non-lethal capabilities. Many of these gaps are common across all NATO nations. The next section addresses some of the possible solutions to mitigate these gaps using existing NATO capabilities, novel technologies, as well as non-materiel solutions (such as changes to the techniques, tactics and procedures (TTPs)).

Table 4. *Counter-personnel NLW requirements. Green means the capability is met, yellow it is partially met and red means it is not met at all.*

	Requirement
CP-WI	Warn individuals
CP-ID	Tag or mark individuals
CP-MI01	Move individuals out of an open area (Land)
CP-MI02	Move individuals out of a confined area (Air/Land/Maritime)
CP-MI03	Move individuals within or out of buildings (Land)
CP-DA01	Deny access to individuals in an open area (Land)
CP-DA02	Deny access to individuals in a confined area (Land/Air/Maritime)
CP-DA03	Deny access to individuals to facilities (Land/Maritime)
CP-DA04	Deny access to individuals on or under water (Maritime)
CP-DI01D	Degrade individuals in an open area (Land/Maritime)
CP-DI01S	Stop individuals in an open area (Land/Maritime)
CP-DI01K	Disable individuals in an open area (Land/Maritime)
CP-DI02D	Degrade individuals in a confined area (Air/Land/Maritime)
CP-DI02S	Stop individuals in a confined area (Air/Land/Maritime)
CP-DI02K	Disable individuals in a confined area (Air/Land/Maritime)
CP-DI03D	Degrade individuals in a building (Land)
CP-DI03S	Stop individuals in a building (Land)
CP-DI03K	Disable individuals in a building (Land)

Table 5. *Counter-materiel NLW requirements*

	Requirement
CM-ID	Tag/mark vehicles, vessels, and aircraft in an open or confined area
CM-DA01	Deny access to vehicles in an open or confined area (Land)
CM-DA02	Deny access to surface and submerged vessels in an open or confined area (Maritime)
CM-DA03	Deny the use of landing zones or airfields by aircraft (Land)
CM-DM01	Degrade, stop or disable vehicles in an open or confined area (Land)
CM-DM02	Degrade, stop or disable vessels in an open or confined area (Maritime)
CM-DM03	Degrade or disable weapons (including explosive devices), sensors, and communication equipment (Air/Land/Maritime)
CM-MA	Divert aircraft in the air

3 Sumary and Recommendations

3.1 Summary

This paper presents a Canadian-specific non-lethal weapons capability-based analysis leveraging the work of NATO SAS 078 study group combined with Canadian force development scenarios. A set of 18 counter-personnel and eight (8) counter-materiel requirements were identified. Since the CF has only nascent NLW capabilities, the identified gaps were significantly greater that the NATO-wide gaps identified by SAS 078. A series of quick mitigation options as well as technological solutions to the identified gaps were provided.

3.2 Recommendations

In the view of this analysis, it is recommended to establish a CF-wide non-lethal weapons action group that will:

- Revisit the requirements in the view of changing strategic priorities and lessons learned from Haiti and Afghanistan;
- Prioritize requirements and identify which capabilities would be desirable in short (1-10 years) and medium term (10-20 years);
- Establish liaison and active collaborative efforts with allied R&D programs to leverage the expertise of other countries that have more mature NLW programs;
- Establish NLW program within Defence R&D community and establish collaboration with industry and academia.

3.3 Future Plans

NATO Research and Technology Organization approved SAS 094 study that will support NATO NLW concept of employment development. Canada will participate in the study, and the results will enable further expansion of the Canadian NLW program.

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References

[1] NATO Non-Lethal Weapon Policy, 1998

[2] NATO SAS 078: Non-Lethal Weapons Capability-Based Analysis, Background Presentation to NATO RTO, 2008

[3] CANADA FIRST: Defence strategy, Government of Canada, 2009

[4] Chief of Force Development, Unclassified Force-Development Scenarios, Accessed on DWAN, 2009

[5] NATO SAS 078 and ACT Non-Lethal Weapons Force Employment Vignettes, 2009

[6] NATO Non-Lethal Weapons Requirements, ACT/ACO bi-command publication, 2009

[7] Besoins Non-Létaux de l‟Armée Canadienne, Maj Dufour for DLR, 26 Nov 2009

[8] ACT/SAS 078 Non-Lethal Weapons Solutions Workshop Results, Draft Version, June 2011

[9] SAS 078 Gap Analysis Summary, 2010

[10] SAS 078 Gap Solution Analysis Summary, October 2011

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Annex A: CFD Scenarios

Attached is a brief summary of the unclassified CFD strategic scenarios that this study used as a basis for the NLW CBA [4].

Scenario 1: Search and Rescue

This scenario involves a rescue mission to save passengers and crew of a cruise liner in distress in Canadian waters. There is a possible risk of panic that would lead to unruly crowd behaviour.

Scenario 2: Disaster Relief in Canada

The second scenario is a major natural disaster in Canada. There is a possibility that a breakdown in the functioning of civil authorities would produce a situation in which some gang activity might arise, potentially threatening the safety of the citizenry. Looting is probable but likely disorganized. Most looters will be unarmed but small arms could be encountered. Security forces need to be able to deal with these threats while under intensive media scrutiny.

Scenario 3: International Humanitarian Assistance

The third scenario is a provision of humanitarian aid in a third-world country. Large numbers of people (tens of thousands) are living in refugee camps with the lack of basic necessities such as food, water and shelter. There are small independent ethnic and self-interest groups (10-100 people) that operate throughout the country as armed local gangs of criminals. Local forces are mostly inefficient. Interests in obtaining relief and medical supplies for their own use and for re-sale on the black market may exist within the ethnic/self-interest groups. As a result, the threat from the local gangs to staging areas and/or convoys will be medium to high. The danger is mainly small arms fire.

When dealing with the local population groups the international forces must be seen as impartial or there could be a risk of retaliatory action that could raise the level of threat. The country's regular military pose no threat to operations but cannot provide much support either. In other similar operations, the provision of protection to convoys and the direct distribution of supplies could be a part of the CF‟s mission. In the latter case the level of protection required could be greater than simple self-protection.

Scenario 4: Surveillance/Control of Canadian Territory and Approaches

This scenario considers surveillance and interception operations in Canadian coastal waters. A drug cartel is bringing in large amounts of drugs and the CF were tasked with the interception. There are no true enemy forces in this scenario. The targets, the vessels and aircraft transporting the contraband, are the enemy. The threat level is low, as the target platforms are likely to be carrying only small automatic weapons and pistols. The ships could also have small shoulder-launched anti-aircraft missiles, but this is considered unlikely. The ships may also be rigged with explosives to scuttle the vessels before evidence can be collected for criminal prosecution should a capture be attempted. The vessel size can range from small fishing boats to larger cargo vessels.

Scenario 5: Evacuation of Canadian Citizens Overseas

The fifth scenario requires a use of CF assets to evacuate Canadian citizens from a country that fell into political turmoil, potentially leading to a coup. The military of this country is not state-of-the-art, but has all of the standard capabilities, albeit obsolete.

The local government have indicated that an emergency evacuation of Canadian citizens would not be opposed by any Government security forces as long as the evacuation was conducted peacefully and no harm was inflicted on the local population. However, there is a potential for uncontrolled violence to break out. If this happens, Canadian property and/or personnel may be seized, damaged or detained; in addition, fighting may break out between political factions, which in turn could degenerate into anarchy in which Canadian lives and property may be put at risk.

Scenario 6: Peace Support Operations (Chapter 6)

This is a traditional peacekeeping scenario with two states requesting United Nations (UN) assistance in negotiations, and to observe compliance with an armistice. Both sides of the conflict have sizable military forces that are one or two generations behind the state-of-the-art. The general threat level should be low, with some regions assessed as moderate. Both nations are eager to end military operations against each other and their impact on their respective economies. As long as the peace process continues successfully, and the economies improve, the likelihood of returning to insurgency and counter-insurgency operations will be remote. In general both countries populations may be predisposed towards unorganized crime such as the stealing food and supplies due to their relatively impoverished state.

Scenario 7: Aid of the Civil Power

The seventh scenario is a domestic situation in which the law and order breaks down and a violent uprising ensues. Civilian law enforcement agencies lose control; the CF is called upon to assist in restoring the law and order. The delicacy of this situation with respect to public opinion and support is obvious. Too great or heavy-handed response may generate a larger insurgency in the region. The armed group conduct hijackings, armed assaults, and possibly have access to some explosives as well. Directly defeating the CF will not be an objective. The insurgent groups will want to make the CF look bad to generate widespread popular political support that could translate into increased tempo of operations against the security forces.

Scenario 8: National Sovereignty/Interests Enforcement

This scenario is an interception and an enforcement of national interests off the cost of Canada. The opposition is combined civilian/military threat at sea, with some related protests domestically. The enemy possesses a military force with a full range of combat capability, with an emphasis on maritime operations. Its armed forces have current generation equipment and modern tactical doctrine. Its command and control assets are considered to be state-of-the-art. The navy size is greater than that of Canada and includes aircraft carrier capability.

Scenario 9: Peace Support Operations (Chapter 7)

This scenario is a large country occupying a part of territory of another country. UN authorizes the use of force to reclaim the territory and to restore peace in the area. The CF deploys as a part of a US-led coalition. The threat is from a conventional military force. However, it is also possible that the forces will encounter refuges and possible paramilitary forces infiltrating occupied territories.

Scenario 10: Defence of Canada/US Territory

This scenario is a decisive action by the Canada-US coalition against a third country that has become a hotbed of state-sponsored drug cartels. However, there is a threat of retaliation by a large ally of this drug state that opposes US policies in principle. The enemy is organized and deployed to defend against attacks from neighbouring countries. However, in recent years its naval strike forces have increasingly ventured to conduct deep-water naval operations.

The enemy poses both a conventional an unconventional threat to Canada and the US. Intelligence assessments indicate that it has the capability and the political will to deploy submarines off the coasts of North America. These submarines could attack shipping transiting to and from Canada and the US or launch a cruise missile attack into Canada/US territory. There is also a threat of cyber-attacks and the enemy has demonstrated an ability to insert small terrorist squads into countries to carry out selective operations.

Scenario 11: Collective Defence

The last scenario is a collective defence under NATO Article 5. One of the new NATO countries is attacked by a larger neighbour; NATO invokes Article 5 and deploys to assist its member. The aggressor possesses military forces with a full range of conventional capabilities. This scenario is a full out conventional war.

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Annex B: NATO NLW-Related Vignettes

In order to identify NATO-wide NLW requirements, SAS 078 study group in collaboration with the NATO Allied Command Transformation (ACT) conducted a requirement workshop that identified 37 possible vignettes covering a wide range of operations that may require use of non-lethal weapons ([2], [5], and [6]).

Vignette 1 "Ambush on Patrol"

After an improvised explosive device (IED) attack with no casualties, convoy is tasked to cordon a building to which suspected insurgents retreated. The task is to prevent anyone from entering or leaving the building.

Vignette 2 "Bio Attack"

Host nation security forces‟ base was subject to a bio-attack. Coalition forces are tasked with establishing outer perimeter to prevent personnel from entering/leaving the base to avoid further spread of the disease.

Vignette 3 "Helicopter down"

During insertion phase of a peacekeeping mission a helicopter is downed. A hostile crowd forms in the vicinity of the site and threatens both the downed helicopter and the helicopter sent in to rescue the crew. A patrol sent in must make way through the crowd and secure the crash-site perimeter.

Vignette 4 "Mega-City Failure - Hostages"

A high-ranking UN official and his entourage were ambushed and are being kept hostages in a refugee camp by a group of criminal/terrorists armed with small arms and explosives. In addition, they use about 100 camp residents as human shields. Special Operations Forces (SOF), supported by additional infantry units is tasked with rescuing the hostages while minimizing casualties.

Vignette 5 "Mega-City Failure - Looting"

Huge crowd (several thousand people) gathers to loot UN food and aid storage warehouses. Three companies are tasked from preventing the looting and to disperse the crowd.

Vignette 6 "NATO Citizen Evacuation"

NATO forces are tasked with evacuation of civilians from a building surrounded by a determined crowd using obstacles and barbed wire to prevent the evacuation.

Vignette 7 "NATO Frigate –Supertanker"

This vignette presents a possible suicide attack at a port in Indian Ocean using hijacked supertanker that needs to be stopped before entering port.

Vignette 8 "NATO Frigate – Freight Ship in Harbour"

A frigate is in a commercial port for refuelling and crew exchange after a 12 months deployment. A freighter is approaching the port. There is a risk of pirates having gained control of the freighter while en route. The frigate has to stop the freighter before it enters the kill zone in the case of a possible suicide attack.

Vignette 9 "NATO Frigate – Small Plane"

A frigate approaching port during a demonstration of force exercise is subject to a possible suicide attack using a small plane. The crew has less than 30 sec to prevent the attack. The approaching small plane may be civilian plane with no hostile intent.

Vignette 10 "NATO Frigate –Speed Boats in Harbour"

A frigate tied to a pier in a commercial harbour has to prevent a potential suicide attack by speedboats engaged in a race in its vicinity. The boats conduct multiple laps, and each lap seems to bring them closer and closer to the frigate. The shortest distance is about 100 m. The frigate has to determine their intent and counteract possible attack.

Vignette 11 "NATO NRF Convoy Operations"

NATO conducts convoy operations in support of a humanitarian mission. A convoy consists of multiple segments moving several minutes apart. These are accompanied by force protection armoured personnel carriers. The convoy moves in regular traffic, with numerous civilian vehicles trying to pass it by moving from gap to gap. There is a risk of suicide bombers. The force protection must prevent potential suicide bombings while avoid civilian casualties.

Vignette 12 "NRF – Support to Elections"

An infantry platoon is posted at a checkpoint, with a small crowd (approximately 200 individuals) gathered at the checkpoint. A local informant pointed out three individuals in the crowd as suicide bombers. He is considered generally reliable, but has a record of providing false information for his personal gain. The security forces must react to the threat.

Vignette 13 "Patrol on Foot – Aggressive Gang"

A platoon-sized foot patrol in a large town encounters a small group (around 20) of young males armed with small arms and RPGs robbing a marketplace. There are about 100 civilians, possibly armed with knives and machetes, present. The patrol must disarm the group and guard the weapons and detainees until support unit arrives.

Vignette 14 "Plane Crash"

A reconnaissance plane crashed in mountainous terrain. Section-sized quick reaction force (QRF) was deployed to the crash site to secure the remains of the pilot as well as the wreckage. The QRF must protect the site from locals (children and adults) and from a potential insurgent attack for up to 36 hours.

Vignette 15 "POW Camp"

Approximately 350 militias, treated as POWs, are interned in a large compound with a number of barracks and tents to house them. After a riot broke out, an infantry company guarding the compound was ordered to restore the order while minimizing casualties.

Vignette 16 "Ship Boarding Operation"

A boarding company is inserted via helicopter to a freighter to verify compliance with an embargo. The ship looks abandoned; there is no trace of crew. The boarding team consists of nine members.

Vignette 17 "Warlord Arrest Operation"

A known warlord wanted for his involvement in piracy is to be captured and extracted from a small village where he is visiting with a small group of bodyguards (just over 10). There are approximately 200 villagers present. The operation will be conducted by SOF teams, equipped and armed "as you wish". They will have helicopters (transport and attack) and two AC130 gunships available.

Vignette 18 "Military Camp Spy Out"

A suspicious vehicle attempts to escape from a checkpoint after guards reported that there was a camera on the dash. There is a QRF on 2 minute notice. The access road to the base consists of 500m paved stripe that transition into a narrow and curvy road. The guards must stop the vehicle.

Vignette 19 "Mobile Checkpoint"

Coalition forces are employing a mobile checkpoint to prevent drug traffickers and insurgents from smuggling drugs across a border. An eighteen-wheeler approaches the checkpoint at high speed (80km/h) and disregards posted signs. The checkpoint personnel must stop the truck and prevent a potential suicide attack.

Vignette 20 "Village Search"

The security forces have a task to cordon and search buildings in a remote village. They have to stop and seize persons trying to escape from the cordoned buildings.

Vignette 21 "Refugee Camp Crisis"

A large refugee camp (50,000 people) is plagued by robberies, violence, and a lack of food and hygienic necessities. Non-government Organizations (NGOs) refuse to work there because of unsafe conditions and a large number of their workers being killed. Two NATO companies were tasked with restoring order and delivering food supplies to the camp. The tasks include securing perimeter, preventing unauthorized entry, separating violent groups from the rest of the camp population, and securing humanitarian deliveries.

Vignette 22 "Caribbean Drug Smuggling"

Drug smugglers use speed boats to move their cargo from South America to the US. They use variety of tactics to avoid detection and subsequent prosecution. The speed boats are too fast and too manoeuvrable to be intercepted by military ships. Helicopters are used to track the speed boats. They need to stop or slow them down significantly enough to enable intercept and investigation by naval forces.

Vignette 23 "Television Station"

Approximately 10 insurgents/terrorists occupy a television station building and keep its employees hostages. They beheaded one of the hostages, and threaten to kill one hostage every 24 hours. A SOF team is tasked to free the hostages and eliminate terrorists. The hostages are in two groups, located at different floors of the five-storey building.

Vignette 24 "Divers in Harbour"

A frigate in a harbour is on high alert because of recent attempts of terrorist attacks on ships. A harbour security spots three divers entering water at night and warns the ship. Ship"s forward guard (a small barge with eight soldiers onboard) detects a suspicious object 20 m deep and about 50 m from the frigate – possibly one of the divers. They have to prevent a potential attack on the ship.

Vignette 25 "Hi-jacked Relief Convoy"

Approximately 40 gang members armed with hand-held weapons, rocket-propelled grenades (RPG) and machetes hi-jacked relief convoy and took its crew as hostages. Three mounted patrols (20 soldiers) are instructed to intercept and stop the convoy and hold it until a QRF (a SOF platoon supported by a helicopter and armoured personnel carriers (APCs)) arrives to resolve the situation.

Vignette 26 "Monastery Protection"

Ethnic clashes led to a deployment of a UN peacekeeping mission. Extremist groups try to set churches and monasteries on fire. NATO platoon was deployed to protect a historic monastery. Five cars with young males arrive to the site, and provoke guards while recording the entire scene. The security platoon moves in to arrest the members of the aggressive group.

Vignette 27 "Relief Convoy Escort"

A relief convoy accompanied by a military escort is en route to deliver supplies to refugee camps. As it transits a village it is intercepted by a crowd of 200 mostly women, children and elderly trying to loot supplies. This has to be prevented to discourage similar incidents in the future. Negotiations fail to yield results, so the commander on the ground makes the decision to clear the road. The escort consists of five armoured trucks with 10 soldiers each.

Vignette 28 “Ambulance Escort”

Two APCs (10 soldiers each) escort an ambulance in a city. After hitting a choke point, they have to clear obstacles. In the mean time they notice a suspicious van approaching at high speed. They have to protect the ambulance and prevent looting. There are other vehicles approaching the choke point to cross as soon as the road is clear.

Vignette 29 “School Bus Escort”

A single APC with 10 soldiers escorts a school bus with children through a village hostile to the children‟s ethnic group. A crowd of approximately 120 people gathered at a bridge to demand money. They started throwing rocks. A tractor is being pulled to the bridge. The commander decides to push ahead and clear the road to enable passage of the bus.

Vignette 30 “Distribution of Relief Supplies”

A platoon of mounted infantry escorts a relief convoy. Upon arrival at the distribution site, a large crowd of several hundred people has formed. The escort has to line up the waiting people, create room for the convoy vehicle, and to ensure everyone‟s safety. The crowd begins to panic.

Vignette 31 “Refugee Camp Riot”

A riot erupts in a refugee camp upon relief convoy‟s arrival. Two companies are tasked with protecting the convoy and dispersing the crowd of several thousand people.

Vignette 32 “Bircao Port Protection”

NATO forces are responsible for protection of a key port used for the distribution of humanitarian aid. The port is plagued by crowds of protesters, looting and steeling supplies. A crowd of several hundred people barricaded itself in a medical supply warehouse. Two media helicopters are hovering in the area. The Port force protection and an infantry company must protect the warehouse, arrest and identify individuals occupying it, and divert media helicopters that do not heed acoustic warnings.

Vignette 33 “Hospital Security I”

A violent group of locals entered a small hospital while a large violent crowd gathered at the gate. They hold patients hostage and demand a treatment for their clan. An infantry company was ordered to prevent further intrusions, prevent attacks at the hospital and arrest intruders.

Vignette 34 “Hospital Security II”

About 50 intruders with knives and batons overwhelm guards and force their way into a small hospital. They refuse to leave. An infantry company is ordered to move the intruders out of the building and to prevent re-entry.

Vignette 35 "Riot at Checkpoint"

A checkpoint at a bridge separates two hostile ethnicities. An infantry company guards the checkpoint. A crowd, instigated by a group of middle-aged men in the back, gathers at the checkpoint and demands passage. The crowd becomes violent; they throw a Molotov cocktail which injures several soldiers. A soldier is dragged out of the line and severely beaten. A counter-crowd gathers at the other side of the bridge. The commander must rescue the snatched soldier, prevent bridge crossing that might lead to further violence, and arrest instigators.

Vignette 36 "Prisoner Camp Riot"

A violent crowd gathers in a prison kitchen/dining facility. It takes three security personnel hostage and threatens to kill them. Military Police company is ordered to rescue hostages and restore control of the situation.

Vignette 37 "Urban Operations"

An infantry company must clear a compound containing about 80 one- to three-storey buildings. Approximately 400-800 people and up to 40 insurgents are expected to be in the area. There might be explosives emplaced in the houses. Any arrested insurgents must be kept under control until collected by other forces.

Annex C: SAS 078-Identified Requirements and NATO Capabilities

Following is a detailed summary of the non-lethal weapon requirements and corresponding best NATO capabilities as identified by SAS 078. This is done in order to show the extent to which Canadian gaps could be mitigated by operating in a coalition environment. In the cases when the best available capability was a riot control agent (RCA), a second option was identified for the situations where national policies or international agreements preclude use of RCA. [9]

Counter-Personnel

Task CP-WI-001. Provide warning to individual(s), including operator(s) of vehicles, vessels, and aircraft (Air/Land/Maritime).

This requirement is relevant across almost all the vignettes, and is repeatedly faced by friendly forces in almost any operational environment involving civilians.

Requirement: NATO Forces must be capable of providing warnings to maintain standoff distances, prevent unintended approaches, and help discern target‟s intent. They should be able to selectively target one, few, or many static or moving personnel, either individually or collectively, whether they are protected or unprotected. The desired range is up to 600m, but up to 300m covers most situations and the desired area of effect is 300m in radius. The onset of effect should be immediate, and duration of effect should be at least several seconds to minutes.

Table 6. *Existing capability for the requirement CP-WI-001.*

Context		LRAD, Model 1000X
Domain	All	Land and Maritime
Space	Open and Confined	Y
Characterization		
Target Number	One/Few/Many	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Y
Range*	0m-600m	Y
Coverage	Pt-300m radius	100m radius
Onset	Immediate (0-2 sec)	Y
Duration	Seconds – Minutes	Y

Task CP-ID-001. Tag/Mark individual(s) in an open or confined area (Land/Maritime).

This requirement was identified across vignettes1, 13, 22, 24 and 35.

Requirement: NATO Forces must be capable of overtly or covertly tagging/marking individuals so that they are identifiable and traceable. They should be able to selectively target one, few, or a group of static or moving personnel, either individually or collectively. The desired range is up to and beyond 600m, but up to 300m covers most situations, and the desired area of effect is 50m in radius. The onset of effect should be immediate, and duration of effect should be at least several hours to a few days.

Table 7. *Existing capability for the requirement CP-ID-001.*

Context		Paint Marking Round for FN 303
Domain	Land/Maritime	Y
Space	Open and Confined	Open and Limited Confined
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving	Y
Physical Properties	N/A	N/A
Range*	0m-600m and beyond	10m-100m
Coverage	Pt-50m radius	Point
Onset	Immediate (0-2 sec)	Y
Duration	up to 2 days	Y

Task CP-MI-001. Move individual(s) out of an open area (Land).

This requirement was derived from Vignettes 5, 27 and 35.

Requirement: NATO Forces must be capable of moving and/or channelling individuals who are in the open, out of or through an area. They should be able to selectively target one, few, a crowd or group of static or moving personnel, either individually or collectively, who are unprotected. The desired range is up to and beyond 600m, but up to 100m covers most situations, and the desired area of effect is up to 50m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 8. *Existing capability for the requirement CP-MI-001.*

Context		LRAD, Model 500X
Domain	Land	Y
Space	Open	Y
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected	Y
Range*	0m-600m and beyond	25m-100m
Coverage	Pt-50m radius	13m
Onset	Immediate	Y
Duration	60 min	Y

Task CP-MI-002. Move individual(s) out of a confined area (Air/Land/Maritime).

This requirement was derived from Vignettes 11, 15, 26, 29, 30, and 31.

Requirement: NATO Forces must be capable of moving individuals who are in confined areas (e.g., fenced compound, interior compartment of a vehicle, ship, or airplane) out of those confined areas. They should be able to selectively target one, few, a crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 50m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 9. *Existing capability for the requirement CP-MI-002.*

Context		56mm CM6 Teargas Grenade	Stingball Grenade, 12 Gauge Launching Cup
Domain	All	Land and Maritime	Land and Maritime
Space	Confined	Limited Confined	Limited Confined
Characterization			
Target Number	One/Few/Crowd/Group	Y	Y
Targeting	Individual and Collective	Collective	Collective
Mobility	Static or Moving	Y	Y
Physical Properties	Unprotected or Protected	Y	Y
Range*	0m-600m	50m-200m	5m-90m
Coverage	Pt-50m radius	9m radius	3m radius
Onset	Immediate (0-2 sec)	Y	Y
Duration	60 min	<30 min	<30 sec

Task CP-MI-003. Move individual(s) within or out of buildings (Land).

This requirement was derived from Vignettes 1, 6, 20, 29, 32, 33, 34, 35, 36, and 37.

Requirement: NATO Forces must be capable of moving individuals who are in a building out of the building or into other parts of the building. They should be able to selectively target one, few, a crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 20m covers most situations, and the desired area of effect is up to 200m2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 10. *Existing capability for the requirement CP-MI-003.*

Context		40mm Ferret CS Breaching Round	Stingball Grenade, 12 Gauge Launching Cup
Domain	Land	Y	Y
Space	Building	Y	Limited Building
Characterization			
Target Number	One/Few/Crowd/Group	Y	Y
Targeting	Individual and Collective	Collective	Collective
Mobility	Static or Moving	Y	Y
Physical Properties	Unprotected or Protected	Y	Y
Range*	0m-600m	1m-45m	5m-90m
Coverage	Pt-200m^2	150m^2	28m^2
Onset	Immediate (0-2 sec)	Y	Y
Duration	60 min	<30 min	<30 sec

Task CP-MI-004. Move individual(s) out of an area (Maritime).

This requirement was not derived from the NATO Vignettes, but was identified by the workshop participants as a viable requirement in the context of maritime operations and port protection.

Requirement: NATO Forces must be capable of directing the movement of individuals who are on or underwater (e.g., swimmer or SCUBA diver) out of an area. They should be able to selectively target one or few of moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 11. *Existing capability for the requirement CP-MI-004.*

Context[9]		eLOUD	LRAD, Model 500X
Domain	Maritime	Y	Y
Space	Open or Underwater	Underwater	Open
Characterization			
Target Number	One/Few	Y	Y
Targeting	Individual and Collective	Collective	Collective
Mobility	Moving	Y	Y
Physical Properties	Unprotected or Protected	Y	Unprotected
Range*	0m-600m	0m-500m	25m-100m
Coverage	Pt-10m radius	Y	Y
Onset	Immediate (0-2 sec)	Y	Y
Duration	60 min	Y	Y

Task CP-DA-001. Deny access to individual(s) in an open area (Land).

This requirement was derived from Vignettes 5, 13, 14, 20, 27, and 30.

Requirement: NATO Forces must be capable of preventing individuals who are on foot or some type of open conveyance, such as a bicycle, from entering or leaving a specific area. They should be able to selectively target one, few, a crowd, or group of moving personnel, either individually or collectively, who are unprotected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 50m radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

Table 12. *Existing capability for the requirement CP-DA-001.*

Context		56mm CM6 Teargas Grenade
Domain	Land	Y
Space	Open	Y
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Moving	Y
Physical Properties	Unprotected	Y
Range*	0m-600m	50m-200m
Coverage	Pt-50m radius	9m radius
Onset	Immediate (0-2 sec)	Y
Duration	up to 2 hrs	<30 min

[9] Two capabilities were identified, one functional under water and one functional on the surface.

Task CP-DA-002. Deny access to individual(s) in a confined area (Air/Land/Maritime).

This requirement was derived from Vignettes 2, 4, 15, 21, 26, 29, 30, 31, and 33.

Requirement: NATO Forces must be capable of acting against individuals in a confined area, such as a room in a building, a fenced compound, or an interior compartment of a vehicle, and preventing them from entering or leaving that area or entering another confined area within the same vicinity. They should be able to selectively target one, few, a crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 15m radius. The onset of effect should be immediate, and duration of effect should be up to few hours.

Table 13. *Existing capability for the requirement CP-DA-002.*

Context		56mm CM6 Teargas Grenade
Domain	All	Land and Maritime
Space	Confined	Limited Confined
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Y
Range*	0m-600m	50m-200m
Coverage	Pt-15m radius	9m radius
Onset	Immediate (0-2 sec)	Y
Duration	up to 2 hrs	<30 min

Task CP-DA-003. Deny access to individual(s) to facilities (Land/Maritime).

This requirement was derived from Vignettes 1, 5, 33, 34, and 35.

Requirement: NATO Forces must be capable of preventing individuals from entering into facilities (land and sea-based) by denying the use of access/entry points. They should be able to selectively target the approaches and access points, either individually or collectively. The desired range is up to 100m, and the desired area of effect is up to 10m radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

The only currently available capabilities were RCA. It was determined that due to the risk of contamination to the facility (which can include food or other humanitarian aid), the RCA were not a viable option.

Task CP-DA-004. Deny access to individual(s) on or underwater (Maritime).

This requirement was derived from Vignette 24.

Requirement: NATO Forces must be capable of preventing individuals who are on or underwater (e.g., swimmer or SCUBA diver) from entering or leaving a specific area. They should be able to selectively target one or few moving personnel, either individually or collectively, who are unprotected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to a few hours.

Table 14. *Existing capability for the requirement CP-DA-004.*

Deny Access to Individuals on or underwater		
Context		eLOUD
Domain	Maritime	Y
Space	Open or Under water	Underwater
Characterization		
Target Number	One/Few	Y
Targeting	Individual and Collective	Collective
Mobility	Moving	Y
Physical Properties	Unprotected	Y
Range*	0m-600m	0m-500m
Coverage	Pt-10m radius	Y
Onset	Immediate (0-2 sec)	Y
Duration	Up to 2 hrs	Y

Task CP-DI-001(Degrade). Degrade individual(s) in an open area (Land/Maritime).

This requirement was derived from Vignettes 1, 5, 12, 13, 14, 16, 17, 27, and 35

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 15. *Existing capability for the requirement CP-DI-001(Degrade).*

Context		80mm "Galix 29" Grenade Acoustic Device
Domain	Land/Maritime	Land
Space	Open	Y
Characterization		
Target Number	One/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Protected	Y
Range*	0m-600m	50m-150m
Coverage	Pt-10m radius	Y
Onset	Immediate (0-2 sec)	Y
Duration	60 min	1-2 sec

Task CP-DI-001(Stop). Stop individual(s) in an open area (Land/Maritime).

This requirement was derived from Vignettes 1, 5, 12, 13, 14, 16, 17, 27, and 35

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 5 minutes.

Table 16. *Existing capability for the requirement CP-DI-001(Stop).*

Stop Individuals in the open		RCA	Non-Chemical
Context		56mm CM6 Teargas Grenade	66mm VLNG 140 5/16" PVC Balls
Domain	Land/Maritime	Y	Land
Space	Open	Y	Y
Characterization			
Target Number	One/Crowd/Group	Y	Y
Targeting	Individual and Collective	Collective	Collective
Mobility	Static or Moving	Y	Y
Physical Properties	Protected	Y	Y
Range*	0m-600m	50m-200m	50m-100m
Coverage	Pt-10m radius	9m radius	Y
Onset	Immediate (0-2 sec)	Y	Y
Duration	Up to 5 min	Y	<30 sec

Task CP-DI-001(Disable). Disable individual(s) in an open area (Land/Maritime).

This requirement was derived from Vignettes 1, 5, 12, 13, 14, 16, 17, 27, and 35

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals in the open to a level that they cannot perform their intended action. They should be able to selectively target an individual, crowd, or group of static or moving personnel, either individually or collectively, who are protected. The desired range is up to 600m, but up to 100m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 5 minutes.

Table 17. *Existing capability for the requirement CP-DI-001(Disable).*

Context		TASER - X26E and M26
Domain	Land/Maritime	Y
Space	Open	Y
Characterization		
Target Number	One/Crowd/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving	Y
Physical Properties	Protected	Y
Range*	0m-600m	0m-12m
Coverage	Pt-10m radius	Point
Onset	Immediate (0-2 sec)	Y
Duration	Up to 5 min	5 sec

Task CP-DI-002(Degrade). Degrade individual(s) in a confined area (Air/Land/Maritime).

This requirement was common across almost all of the Vignettes: 1, 2, 4, 6, 7, 8, 10, 15, 16, 21, 22, 23, 25, 26, 28, 29, 31, 32, 34, 35, and 36.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a confined area to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 18. *Existing capability for the requirement CP-DI-002(Degrade).*

Degrade Individuals in a confined space		
Context		LRAD, Model 1000X
Domain	All	Land and Maritime
Space	Confined	Limited Confined
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Unprotected
Range*	0m-600m	50m-150m
Coverage	Pt-10m radius	Y
Onset	Immediate (0-2 sec)	Y
Duration	Up to 60 min	Y

Task CP-DI-002(Stop). Stop individual(s) in a confined area (Air/Land/Maritime).

This requirement was derived from Vignettes 1, 2, 4, 6, 7, 8, 10, 15, 16, 21, 22, 23, 25, 26, 28, 29, 31, 32, 34, 35, and 36.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a confined area to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 5 minutes.

Table 19. *Existing capability for the requirement CP-DI-002(Stop).*

Stop Individuals in a confined space		RCA	Non-Chemical
Context		56mm CM6 Teargas Grenade	66mm VLNG 140 5/16" PVC Balls
Domain	All	Land and Maritime	Land
Space	Confined	Limited Confined	Limited Confined
Characterization			
Target Number	One/Few/Crowd/Group	Y	Y
Targeting	Individual and Collective	Collective	Collective
Mobility	Static or Moving	Y	Y
Physical Properties	Unprotected or Protected	Y	Y
Range*	0m-600m	50m-200m	50m-100m
Coverage	Pt-10m radius	9m radius	Y
Onset	Immediate (0-2 sec)	Y	Y
Duration	Up to 5 min	Y	<30 sec

Task CP-DI-002(Disable). Disable individual(s) in a confined area (Air/Land/Maritime).

This requirement was derived from Vignettes 1, 2, 4, 6, 7, 8, 10, 15, 16, 21, 22, 23, 25, 26, 28, 29, 31, 32, 34, 35, and 36.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a confined area to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 10m in radius. The onset of effect should be immediate, and duration of effect should be up to 5 minutes.

Table 20. *Existing capability for the requirement CP-DI-002 (Disable).*

Context		TASER - X26E and M26
Domain	All	Y
Space	Confined	Limited Confined
Characterization		
Target Number	One/Few/Crowd/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Y
Range*	0m-600m	0m -12m
Coverage	Pt-10m radius	Point
Onset	Immediate (0-2 sec)	Y
Duration	Up to 5 min	5 sec

Task CP-DI-003(Degrade). Degrade individual(s) in a building (Land).

This requirement was derived from Vignettes 4, 6, 20, and 23.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a building to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 200 m^2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 21. *Existing capability for the requirement CP-DI-003(Degrade).*

Context		Improved Flash Bang Grenade
Domain	Land	Y
Space	Building	Limited Building
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Y
Range*	0m-600m	2m-11m
Coverage	Pt-200m^2	100m^2
Onset	Immediate (0-2 sec)	Y
Duration	60 min	1-2 sec

Task CP-DI-003(Stop). Stop individual(s) in a building (Land).

This requirement was derived from Vignettes 4, 6, 20, and 23.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a building to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd, or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 200m^2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 22. *Existing capability for the requirement CP-DI-003(Stop).*

Context		Improved Flash Bang Grenade
Domain	Land	Y
Space	Building	Limited Building
Characterization		
Target Number	One/Few/Crowd/Group	Y
Targeting	Individual and Collective	Collective
Mobility	Static or Moving	Y
Physical Properties	Unprotected or Protected	Y
Range*	0m-600m	2m-11m
Coverage	Pt-200m^2	100m^2
Onset	Immediate (0-2 sec)	Y
Duration	60 min	1-2 sec

Task CP-DI-003(Disable). Disable individual(s) in a building (Land).

This requirement was derived from Vignettes 4, 6, 20, and 23.

Requirement: NATO Forces must be capable of decreasing the physical functionality of individuals who are in a building to a level that they cannot perform their intended action. They should be able to selectively target one, few, crowd or group of static or moving personnel, either individually or collectively, who are unprotected or protected. The desired range is up to 600m, but up to 300m covers most situations, and the desired area of effect is up to 200m2. The onset of effect should be immediate, and duration of effect should be up to 60 minutes.

Table 23. *Existing capability for the requirement CP-DI-003(Disable).*

Disable Individuals in a building		RCA	Non-Chemical
Context		Non-Lethal Hand Grenade CS	TASER - The X26E and M26
Domain	Land	Y	Y
Space	Building	Limited Building	Limited Building
Characterization			
Target Number	One/Few/Crowd/Group	Y	One
Targeting	Individual and Collective	Collective	Individual
Mobility	Static or Moving	Y	Y
Physical Properties	Unprotected or Protected	Y	Y
Range*	0m-600m	2m-30m	0m-12m
Coverage	Pt-200m^2	Y	Point
Onset	Immediate (0-2 sec)	15 sec**	Y
Duration	60 min	<30 min	5 sec

Counter-Materiel

Task CM-ID-001. Tag/Mark vehicles, vessels, and aircraft in an open or confined area (Air/Land/Maritime).

This requirement was derived from Vignette 22.

Requirement: NATO Forces must be capable of overtly or covertly tagging/marking vehicles, vessels or aircraft, so that they are identifiable and/or traceable. They should be able to selectively target one, few, or a group of static or moving vehicles, either individually or collectively. Desired range is up to and beyond 600m, but up to 600m covers most situations, and desired area of effect is 10m in radius. A short delay in onset is acceptable, and duration of effect should be at least several hours to 12 months.

Table 24. *Existing capability for the requirement CM-ID-001.*

Context		Paint Marking Round for FN 303
Domain	ALL	Land and Maritime
Space	Open and Confined	Y
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving	Y
Physical Properties	N/A	N/A
Range*	0m-600m and beyond	0m-100m
Coverage	Pt-10m radius	Point
Onset	Short delay acceptable	Y
Duration	Hrs to 12 months	2 days

Task CM-DA-001. Deny access to vehicles in an open or confined area (Land).

This requirement was derived from Vignette 20.

Requirements: NATO Forces must be capable of restricting movement of suspicious or potentially threatening vehicles in NATO controlled or uncontrolled areas. They should be able to selectively target one, few, or groups of moving vehicles, either individually or collectively. Target vehicles may be moving at up to 100 kph and may weigh up to 30 tons. Desired range is up to 1000m depending on the size and speed of the vehicle, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 10 minutes.

Table 25. *Existing capability for the requirement CM-DA-001.*

Deny access to vehicles		
Context		X-Net 10T SNS Spiked Net 18″L x 15″W
Domain	Land	Y
Space	Open and Confined	Confined
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Moving (up to 100 kph)	Y
Physical Properties	Up to large trucks	20,000lbs
Range*	0m-1000m	Hand Emplaced
Coverage	Pt-10m radius	Point
Onset	Immediate	Y
Duration	10 min	Y

Task CM-DA-002. Deny access to surface and submerged vessels in an open or confined area (Maritime).

This requirement was not derived from a particular vignette, but it was identified by the participants of the ACT requirements workshop as a valid requirement. There are no capabilities meeting this requirement.

Requirement: NATO Forces must be capable of influencing movement of suspicious or potentially threatening surface or submerged vessels. They should be able to selectively target one, few, or groups of moving vessels, either individually or collectively. Target vessels may be moving at up to 75 kph and may be any type of vessel. Desired range is up to and beyond 600m, but up to 1000m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 10 minutes.

Task CM-DA-003. Deny the use of landing zones or airfields by aircraft (Land).

This requirement was derived from Vignette 32. There are no available NLC meeting this requirement.

Requirement: NATO Forces must be capable of restricting aircraft use of airfields and landing zones in NATO controlled or uncontrolled areas to deter illegal activity, covert actions, and enforce sanctions. They should be able to selectively target landing zones and airfields. Desired range is up to and beyond 600m and desired area of effect is 20m by 50m. Onset of effect should be immediate, and duration of effect should be at least 24 hours (adjustable duration is preferred).

Task CM-DM-001(Degrade). Degrade vehicles in an open or confined area (Land).

This requirement was derived from Vignettes 11, 17, 26, and 28.

Requirement: NATO Forces must be capable of decreasing the performance or completely limiting the functions of suspect vehicles to prevent adversary use as escape or attack vehicles. They should be able to selectively target one, few, or groups of static or moving vehicles, either individually or collectively. Target vehicles may be static or moving at up to 100 kph and may weigh up to 30 tons. Desired range is up to 1000m depending on the size and speed of the vehicle, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 60 minutes.

Table 26. *Existing capability for the requirement CM-DM-001(Degrade).*

Context		Caltrops
Domain	Land	Y
Space	Open and Confined	Y
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving (up to 100 kph)	Moving
Physical Properties	Up to large trucks	Y
Range*	0m-1000m	Hand emplaced
Coverage	Pt-10m radius	Y
Onset	Immediate	Y
Duration	60 min	Y

Task CM-DM-001(Stop). Stop vehicles in an open or confined area (Land).

This requirement was derived from Vignettes 11, 17, 26 and 28.

Requirement: NATO Forces must be capable of decreasing the performance or completely limiting the functions of suspect vehicles to prevent adversary use as escape or attack vehicles. They should be able to selectively target one, few, or groups of moving vehicles, either individually or collectively. Target vehicles may be moving at up to 100 kph and may weigh up to 30 tons. Desired range is up to 1000m depending on the size and speed of the vehicle, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 60 minutes.

Table 27. *Existing capability for the requirement CM-DM-001(Stop).*

Context		X-Net 10T SNS Spiked Net 18˝L x 15˝W
Domain	Land	Y
Space	Open and Confined	Confined
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Moving (up to 100kph)	Y
Physical Properties	Up to large trucks	20,000lbs
Range*	0m-1000m	Hand Emplaced
Coverage	Pt-10m radius	Point
Onset	Immediate	Y
Duration	60 min	Y

Task CM-DM-001(Disable). Disable vehicles in an open or confined area (Land).

This requirement was derived from Vignettes 11, 17, 26, and 28. There were no NLC meeting this requirement.

Requirement: NATO Forces must be capable of decreasing the performance or completely limiting the functions of suspect vehicles to prevent adversary use as escape or attack vehicles. They should be able to selectively target one, few, or groups of static vehicles, either individually or collectively. Target vehicles would not be moving and may weigh up to 30 tons. Desired range is up to 1000m, but 600m covers most situations. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least 60 minutes.

Task CM-DM-002(Degrade). Degrade vessel(s) in an open or confined area (Maritime).

This requirement was derived from Vignettes 16 and 22. There were no NLC meeting this requirement.

Requirement: NATO Forces must be capable of stopping or decreasing the performance or completely limiting the functions of surface or submerged vessels. They should be able to selectively target one, few, or groups of static or moving vessels, either individually or collectively. Target vessels may be moving at up to 75 kph and may be any type of vessel. Desired range is up to 1000m. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least a few hours.

Task CM-DM-002(Stop). Stop vessel(s) in an open or confined area (Maritime).

This requirement was derived from Vignettes 16 and 22.

Requirement: NATO Forces must be capable of stopping or decreasing the performance or completely limiting the functions of surface or submerged vessels. They should be able to selectively target one, few, or groups of moving vessels, either individually or collectively. Target vessels may be moving at up to 75 kph and may be any type of vessel. Desired range is up to and beyond 1000m. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least a few hours.

Table 28. *Existing capability for the requirement CM-DM-002(Stop).*

Context		RGES Shoulder Launched Device
Domain	Maritime	Y
Space	Open, Confined, and Underwater	Open and Confined
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Moving (up to 75 kph)	Y
Physical Properties	Any kind of vessel	Propeller driven
Range	0m-1000m and beyond	0m-30m
Coverage	Pt-10m radius	Point
Onset	Immediate	Short delay*
Duration	2 hours	Y

Task CM-DM-002(Disable). Disable vessel(s) in an open or confined area (Maritime).

This requirement was derived from Vignettes 16 and 22. There were no NLC meeting this requirement.

Requirement: NATO Forces must be capable of stopping or decreasing the performance or completely limiting the functions of surface or submerged vessels. They should be able to selectively target one, few, or groups of static vessels, either individually or collectively. Target vessels will not be moving and may be any type of vessel. Desired range is up to and beyond 1000m. Desired area of effect is 10m in radius, onset of effect should be immediate, and duration of effect should be at least a few hours.

Task CM-DM-003(Degrade). Degrade weapons (including explosive devices), sensors, communication equipment (Air/Land/Maritime).

This requirement was derived from vignettes 1, 4, 12, 13, 17, 23, 26, and 36. Note that the operations such as in Libya would benefit from the ability to use reversible means of reliably disabling weapon systems.

Requirements: NATO Forces must be capable of decreasing the performance or completely limiting the functions of weapons (including explosive devices), sensors, and communication equipment. They should be able to selectively target one, few, or groups, either individually or collectively. The target may be static or moving. Desired range is up to and beyond 600m. Desired area of effect depends on the scenario, but 50m in radius was used as a guideline. The onset of effect should be immediate, and duration of effect should be at least a few hours.

Table 29. *Existing capability for the requirement CM-DM-003(Degrade).*

Context		GBD-IIIC
Domain	All	Y
Space	Open and Confined	Open and Limited Confined
Characterization		
Target Number	One/Few/Group	One
Targeting	Individual and Collective	Individual
Mobility	Static or Moving	Y
Physical Properties	N/A	N/A
Range*	0m-600m and beyond	114m -1000m
Coverage	Pt-50m radius	Point
Onset	Immediate	Y
Duration	Up to 2hrs	Y

Task CM-DM-003(Disable). Disable weapons (including explosive devices), sensors, communication equipment (Air/Land/Maritime).

This requirement was derived from vignettes 1, 4, 12, 13, 17, 23, 26, and 36. Note that the operations such as in Libya would benefit from the ability to use reversible means of reliably disabling weapon systems. There are currently no NLC meeting this requirement.

Requirement: NATO Forces must be capable of decreasing the performance or completely limiting the functions of weapons (including explosive devices), sensors, and communication equipment. They should be able to selectively target one, few, or group, either individually or collectively. The target may be static or moving. Desired range is up to and beyond 600m. Desired area of effect depends on the scenario, but 50m in radius was used as a guideline. The onset of effect should be immediate and the duration of effect should be at least a few hours.

Task CM-DM-004. Degrade/Disable facilities (Land/Maritime).

Requirement: NATO Forces must be capable of decreasing the performance or completely limiting the functions of facilities.

Based on the wide variety of facilities this task encompasses, the task is beyond the scope of this CBA.

Task CM-MA-001. Stop an aircraft on the ground (Land).

This requirement was not derived from the identified Vignettes. However, it was identified as a valid requirement, which is confirmed by current operations in Libya. There are currently no NLC meeting this requirement.

Requirement: NATO Forces must be capable of stopping an aircraft on the ground in NATO controlled and uncontrolled areas. They should be able to target one aircraft. Target aircraft may

be static or moving (on the ground) and may be any type of aircraft. Desired range is up to and beyond 1000m. The onset of effect should be immediate, and duration of effect should be at least a few hours.

Task CM-MA-002. Divert an aircraft in the air (Air).

This requirement was derived from Vignettes 9 and 32. There is no NLC addressing this requirement.

Requirement: NATO Forces must be capable of re-directing an aircraft in the air to prevent entry into designated airspace. They should be able to target one aircraft. Target aircraft may be moving (up to 800 kph) and may be any type of aircraft. Desired range is 5000m for high speed aircraft and 1500m for other aircraft. The onset of effect should be immediate, and duration of effect should be up to 30 minutes.

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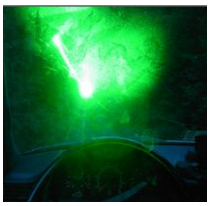
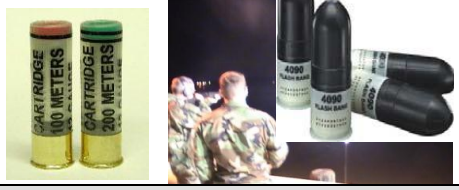
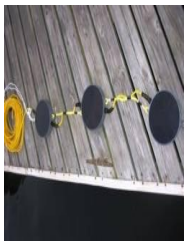
Annex D: NATO-wide Non-Lethal Capabilities

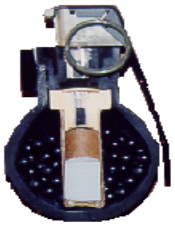
Annex D provides a list of all NATO non-lethal capabilities currently fielded or programmed (in the procurement process) based on Ref. [9] .

Counter-Personnel
Electromagnetic
GBD-IIIC: USA
  A handheld or weapon mounted, non-blinding laser that has reversible optical effects during daylight and periods of reduced visibility. The device has a safety module that turns the beam off when obstructions are detected within the meter Nominal Ocular Hazard Distance.
X-26 TASER: USA, NLD, DNK
 A handheld weapon that launches two tethered barbs to deliver an electro-muscular disruption charge (50,000 volts).
M2 Mini-Green Laser: USA, NOR
 The M2 Mini Green Laser Designator is a multifunction laser illuminator/target designator designed for handheld, standard mil-rail weapon mounted or tripod use. It provides optical effects during periods of reduced visibility.
Acoustic
9-Bang Flash Bang Grenade: CAN
 The NICO 9-bang sound & flash grenade is designed to incapacitate subjects for up to 3 seconds by delivering 9 consecutive “flashes” and “bangs”. It is intended to disperse a crowd, create a diversion or to incapacitate occupants within a room or a closed space. Once fired, the body cannot be reused or reloaded.

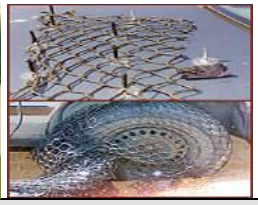
M-84 : USA	
	The M-84 is a hand thrown grenade that delivers a bright flash (optical effect) and loud bang (acoustic effect). It is 4.89 inches long, 1.32 inches in diameter and weighs 14.4 ounces.
Improved Flash Bang Grenade: USA	
	A hand thrown flash bang grenade with a top and bottom venting design that enhances operator safety, produces a longer flash duration than existing flash bangs and contains environmentally safe payload components.
Joint Non-Lethal Warning Munitions 12 Gauge and 40mm: USA	
	These munitions include 12 gauge and 40mm munitions that deliver flash bang effects with a smoke signature to provide a clear, unambiguous warning signal.
Sound Commander : NLD, USA **LRAD Model 500X/1000X : NOR, USA, NLD, DNK**	
	Ground, vehicle, or vessel mounted long range hailing and warning devices that project sound waves at variable frequencies to deliver warning tones and intelligible voice commands.
eLOUD: USA	
	A man portable, easy to operate unit comprised of a control unit and 75 foot transducer cable that can be deployed from a vessel or pier. The unit transmits intelligible commands underwater.

VENOM Vehicle mounted, 40mm flash bang rounds : USA	
	A mounted, 40mm launcher delivering high voume of NL smoke and/or flash bang rounds.
66mm VLNLG flash bang grenade: USA	
 	Round contains three bursting submunitions with pyrotechnic charges for audio and visual stimuli. The overall length is 25.25 cm (9.94 inches), diameter is 66 mm, and total weight is 725.7 grams (1.6 pounds).
Mechanical/Kinetic	
12 Gauge Sting Ball Round: USA	
	Shotgun round designed to deliver blunt trauma and contains 18, .23 caliber hard rubber pellets.
12 gauge beanbag: NLD, USA, CAN, NOR	
 	The projectile consists of one lead shot-filled fabric bag. On impact, the bag collapses and the shot acts as a fluid medium, distributing its kinetic energy over 4 square inches.
12 gauge rubber fin stabilized round: USA, CAN 12 gauge fin stabilized extended range round: USA	
 	Shotgun rounds that are designed to deliver blunt trauma. The 12 gauge rubber fin stabilized round weighs 7.8 grams and is approximately 2.5 inches long.

M1012 12 gauge Nonlethal, Point Control: USA, NOR	
	The M1012 is a single projectile round made of hard rubber that is shaped like a bomblet that delivers blunt trauma.
12 gauge non-lethal sock round with UV marking: USA	
	A 12 guage non-lethal sock round that provides blunt impact with UV marking. Dye marking is persistent up to 2 days.
12 gauge sock round: USA	
	The 12 gauge sock round consists of a cotton drag-stabilized sock that contains approximately 0.4 ounces of lead shot and is contained in a 12-gauge shotgun shell that is approximately 2.5 inches long. Designed to deliver blunt trauma.
40 mm Sponge Round: DEU, CAN, USA, DNK, FRA, NLD, NOR	
	The sponge point grenade is approximately 4¼ inches long and 1½ inches in diameter. The round is bullet shaped with the rounded front composed of foam rubber and back is composed of hard plastic. Designed to deliver blunt trauma.
40mm Foam Rubber Baton Cartridge: USA, NOR	
	M203 grenade launched round delivers blunt trauma effects. The cartridge contains three foam rubber batons in an aluminum cartridge case.
M1029, 40mm Non-Lethal Crowd Dispersal Grenade: USA	
	M203 grenade launched round delivers blunt trauma effects. The cartridge is a multiple projectile round with 48, .48 caliber hard rubber balls.

Grenade, Rubber Ball: USA, FRA	
	A hand thrown or shotgun launched rubber grenade that releases 100, .25-caliber hard rubber pellets and delivers blunt trauma effects .
Sting ball grenade 12-gauge launching cup: USA	
	An attatchment for the 12 gauge shotgun which provides extended range to the Grenade, Rubber Ball.
Blunt Impact and Paint Marking Rounds for FN 303: USA, NLD	
	The FN 303 Blunt Impact and Paint Marking rounds are fired from a compressed-air powered, shoulder launcher that delivers exclusively non-lethal projectiles. The Blunt Impact Round is a propylene glycol capsule that is 100% non-toxic and the marking rounds colors are either washable-pink or permanent-yellow.
Modular Crowd Control Munitions (MCCM): USA	
 	A command detonated, hand emplaced, non-lethal munition that discharges 600, .32 caliber rubber balls to deliver blunt trauma effect against individuals.
66 mm, VLNLG 140 5/16” PVC balls: USA	
 	A vehicle mounted, remotely fired launcher that discharges 4, 66mm grenades in a single salvo to deliver blunt trauma effect.

Chemical
OC Personal Dispenser: CAN, GBR, DEU, USA, NLD
 Hand held dispenser which provides a single stream of RCA and each dispenser contains approximatley 35, .5 second bursts out to 3-12 feet.
Pepperspray Anti Riot: DEU, USA
 Hand held dispenser which provides a single stream of RCA and each dispenser contains approximately 10, .5 second bursts out to 6-15 feet.
M-37 midsized riot control dispenser OC or CS: DEU, USA
 The M-37 is a midsized riot control dispenser that can deliver 18, 3-second bursts of OC (pepper spray) or CS. It is operated by one individual and easily refilled/pressurized with available maintenance equipment.
Non lethal hand grenade CS : DEU, CAN USA, FRA
  Non-lethal riot-control hand grenades which contain only CS as filler.
40 mm CS ammunition: DEU, USA
 A 40mm CS filled round consisting of a projectile body and cartridge case.
40mm Ferret (CS) breaching round: CAN
 The purpose of the Ferret round is to dislodge barricaded subjects from confined areas. The Ferret round comes as a powder carrier improving penetration potential of the agent. Once delivered, powder carriers keep the agent airborne longer and may have more effect.

66mm VLNLG RCA grenade: USA	
 	Each grenade contains 23 individual canisters filled with CS compound, providing a number of CS sources rather than a single plume.
Oleoresin Capsicum (OC) Round for FN 303: USA	
 	The FN 303 OC Round is fired from a compressed-air powered, shoulder launcher that delivers exclusively non-lethal projectiles. The OC round is orange dyed, with a non-toxic glycol base plus 10% OC liquid.
Counter Material (CM) Applicable NLW	
Spiked Strip Barrier: USA	
	The spike strip is designed to puncture a pneumatic tire as the vehicle makes contact with the spike strip and takes only seconds to deploy. The spikes pivot into the tire, are pulled out of the unit and on the second revolution are pushed directly into the tire, allowing air to escape slowly.
X-Net 3T (VLAD) spiked net 18'L x 9'W: NOR, USA, GBR	
 	The VLAD is a man portable, expandable spiked net that can be deployed in less than one minute and is 18'L x 9'W, weighing 45 lbs. The barbed spikes on the leading edge of the net pierce the front tires and wrap around the tires bringing a vehicle to a stop.
Caltrops: USA	
	Three pronged, heavy gauge steel puncturing spikes that can be thrown or linked together to cause immediate, irreparable, catastrophic failure of pneumatic tires . These devices significantly impede wheeled vehicle movement.

PVAB: USA, NOR, FRA	
	A pre-emplaced, re-usable, mechanically activated vehicle capturing system. This device employs a vertical net, secured to the ground at both ends, to capture a small vehicle and force it to a controlled stop while also confining occupants inside. It can be emplaced by a 3-man team in less than 2 hours.
RGES shoulder launched device: USA	
 	The portable Running Gear Entanglement System (RGES) is a shoulder launched device that utilizes compressed air to launch an entanglement net 100 feet long and made of 7/16 inch spectra rope with tied, weighted loops. The net is fired across the bow of a vessel to entangle the propeller.
Stern-mounted MK10 RGES compressed air launcher: USA	
	The stern-mounted RGES uses a compressed air cylinder launcher and has a removable, fix-mounted launcher on side of craft. The launcher projects an entanglement net 100 feet long and made of 7/16 inch spectra rope with tied, weighted loops ahead of the vessel to entangle the propeller.

Annex E: Solutions to NATO Gaps - Summary

Annex E summarizes findings of SAS 078 Gap Solution Working Group as per Refs. [8] and [10].

Candidate non-materiel solutions typically involved combining different non-lethal weapons (particularly to address gaps associated with area coverage or effect duration), using systems and objects not originally designed as NLW (balloons, wires, etc.), or modifying tactics, techniques, and procedures.

The workshop identified 35 new candidate materiel solutions. The following table shows these candidate solutions and the number of requirements for which each solution was proposed:

Acoustic	Chemical	Electromagnetic	Mechanical	Ancillary/Other
Distributed Sound and Light Array (4 requirements)	Pheromones followed by insects (1 requirement)	Electrified grid (2 requirements)	Water cannon/gun (3 requirements)	Animals (dogs, marine mammals) (4 requirements)
Whistle grenade (3 requirements)	Sleeping agents/ calmatives (4 requirements)	IR/thermal laser (7 requirements)	Riot net (2 requirements)	Radiological/isotope tagging (2 requirements)
Anti-swimmer grenade (2 requirements)	Barrier foams (3 requirements)	Underwater 'sparker' (2 requirements)	Ifex pack (2 requirements)	NL mine field (2 requirements)
	Sticky foam (3 requirements)	Underwater taser (1 requirement)	Barriers/Fences (TACRION) (3 requirements)	Fog system or persistent smoke (6 requirements)
	Anti-traction materials (1 requirement)	RF and HPM to stop engines, disrupt C4ISR, or break detonators (2 requirements)	Underwater vortex/ wave generator (2 requirements)	IR/RF smart dust (3 requirements)
	Combustion modifiers/inhibitors (1 requirement)	Counter sensor laser (1 requirement)	Expanding wires/ microfibers (3 requirements)	Micro-GPS trackers (2 requirements)
	Foam to disable fuses (1 requirement)	Laser modified airflow (1 requirement)	Bubble stream (DiDiMo system) (1 requirement)	
		Taser XREP, multi-shot, and/or shockwave (2 requirements)	Mechanical barriers based on airbag technology (1 requirement)	
			Landing zone obstacles	
			Air turbulence generators and blowers (1 requirement)	
			Constant target velocity weapon (1 requirement)	

Most Versatile Capabilities and Solutions

This section identifies the capabilities and solutions that recurred most frequently in the SAS 078 Gap, and Gap and Solution Analysis, and thus represent the most versatile option if a broad range of requirements is to be met with a limited number of capabilities. They are included here for completeness.

Counter-Personnel Capabilities

The most versatile in-service counter-personnel capabilities were acoustic systems – for example LRAD scored first or second in four instances, and acoustic systems in general ranked first or second in nine instances. The acoustic systems were identified as best capabilities for degrade, move and warn tasks. In two instances where acoustic arrays were not suitable (degrade individuals in buildings) flashbang grenades were the best capability.

Blunt trauma systems had a limited applicability, but in five instances they were the best non RCA options (stop/move individuals) in buildings. Out of the blunt trauma, Stingball with 12 gauge launching cup was the most versatile blunt trauma capability. In the remaining two instances the best option was larger calibre blunt-trauma weapons. FN303 was fairly versatile capability as well, providing reasonable capability for a variety of tasks including tag/mark individuals.

To disable individuals (physiological response independent of compliance), Taser was identified as the best (and outside of the buildings the only) option. The main limitation of Taser is its range and the duration of incapacitation. Research models were providing range up to 40m (sufficient in buildings), but the duration of incapacitation was limited to 30 sec.

The RCA systems were fairly versatile as well, providing the best option in seven instances. However, their use may be severely restricted due to policy issues. In general their use would be limited to crowd confrontation operations. In other situations they would not be a viable option because they would contaminate resources such as food or blankets and render them unusable. In addition, many countries place restriction on the use of RCA due to international conventions on the use of chemical weapons.

In terms of proposed solutions, the ADT was far most versatile materiel solution (best in six instances). In the instances when it is impractical, combination of laser dazzlers and acoustic devices was usually the best option. This includes the DSLA or ad hoc combining of acoustic and optical systems. Supporting them with kinetic rounds further enhanced the ability to meet/mitigate the requirements.

Counter-Materiel Capabilities

The capabilities addressing counter-materiel requirements are very limited. The two that met the *degrade* and *stop* tasks were caltrops and XNET, respectively. Both of them were constrained by the requirement to pre-emplace the capability, and thus had a limited applicability away from channelized communication lines. Remote deployment devices would increase the range and render them more efficient for off-road usage.
The RF engine stopper was the best, and often the only solution at least partially meeting the requirements across the board. Its main limitations were the requirement that the engine must contain electronic control modules, and the radio-wave needs to be able to reach the engine. The latter need is not achievable for instance for larger boats in which case the radio-wave will not penetrate the hull.

Table E1. ***Most versatile counter-personnel capabilities***

Current/Programmed	Candidate Solution	Best or Second Best for following SAS 078-identified requirements
LRAD		CP-WI001, CP-MI-001, CP-MI-004 CP-DI002DEG
Other Acoustic		CP-MI-001, CP-MI-004 CP-DA-004 CP-DI001DEG CP-DI003DEG
Stingball w/ 12g cup		CP-MI-002, CP-MI-003 CP-DI-003STOP
Other blunt trauma		CP-DI-001STOP CP-DI-002STOP
RCA		CP-DA-001, CP-DA-002 CP-MI-002, CP-MI-003 CP-DI-001STOP CP-DI-002STOP CP-DI-003STOP
	ADT	CP-MI-001, CP-MI-002 CP-DA-001, CP-DA-002, CP-DA-003 CP-DI-001DEG
	DSLA	CP-WI-001 CP-DI-002DEG
	Other acoustic/optical	CP-WI-001, CP-MI-001 CP-DI-002DEG

Conceptual Solutions and Mitigation Options

Some of the solutions and mitigation options identified by the ACT solution workshop could not be quantified (and thus assessed). For completeness, they are summarized in Tables D2 and D3.

Detailed technical characteristics were not available for all of the proposed solutions, and consequently they were left in the summary format and were not ranked using the Gap-analysis methodology. The cost factor was not considered at all in the analysis.

Candidate non-materiel solutions typically involved combining different non-lethal weapons (particularly to address gaps associated with area coverage or effect duration), using systems and objects not originally designed as NLW (balloons, wires, etc.), or modifying tactics, techniques, and procedures. Use of animals was proposed on several occasions. The training and care requirements were not considered.

Table E2: Summary of conceptual materiel solutions identified by ACT/SAS 078 Solution Workshop.

Acoustic	Chemical	Electromagnetic	Mechanical/Kinetic	Ancillary/Other
Distributed Sound and Light Array Whistle grenade Anti-swimmer grenade	Pheromones followed by insects Sleeping agents/ calmatives Barrier foams Sticky foam Anti-traction materials Combustion modifiers and inhibitors Foam to disable fuses	**Area Denial Technology** Electrified grid IR/thermal laser Underwater „sparker" Underwater taser **RF** and HPM **to stop engines**, disrupt C4ISR, or break detonators Counter sensor laser Laser modified airflow to affect wings by increasing drag Taser XREP, multi-shot, and/or shockwave	**Water cannon/gun** Riot net Ifex pack Barriers/Fences (TACRION) **Underwater vortex/ wave generator** **Expanding wires/ microfibers** Bubble stream (DiDiMo system) Mechanical barriers based on airbag technology Landing zone obstacles Air turbulence generators and blowers Constant target velocity weapon	Animals (dogs, marine mammals, etc) Radiological/isotope tagging NL mine field Fog system or persistent smoke IR/RF smart dust Micro-GPS trackers

Table E3: Non- materiel solutions identified by ACT/SAS 078 Solution Workshop.

Multiple Systems	Multiple Applications	Non-NLW Solutions
LRAD + GBD 3 (or more generally a combination of acoustic and optical systems) to increase range, enable targeting individuals and to warn aircraft (warn, deny area, degrade or move individuals) **LRAD + RCA** to increase coverage (deny area, move individual, degrade individuals) **LRAD + Blunt trauma** to increase coverage, duration, and targeting (degrade, stop, or move individuals) **RCA + Blunt Trauma** to increase coverage, duration, and targeting (degrade or move individuals) **LRAD + ADT** (deny area, degrade individuals) **Flashbangs + Blunt trauma** to increase range, coverage, duration, and targeting (degrade, stop individuals) **Nets and blunt trauma systems** to increase range, duration, targeting and coverage (deny access, move individuals) **Nets and RCA systems** to increase range, duration, targeting and coverage (deny access, move individuals)	**LRAD arrays, sweeping LRAD beam** to increase coverage (warn, degrade individuals) **Multiple applications of FN303 paint rounds** to increase number of targets and coverage (tag/mark) **Multiple RCA canisters** to enhance coverage and duration (deny area, stop, move or degrade individuals) **Multiple flashbangs** to increase coverage and duration (degrade or move individuals) **Multiple applications of blunt trauma rounds** to increase coverage, number of targets, duration (degrade, stop individuals)	Imagery and facial recognition tools (tag/mark individuals) Use of SOF to tag vehicles and vessels (tag/mark) Set off fire alarms and sprinklers in buildings (move, degrade individuals) Change temperature in buildings (deny access, move or degrade individuals) Use of obstacles, portable barriers (deny access, deny use of runways) Use of party balloons, nets, overhead wires (deny access – air, deny use of landing zones) **Use of smoke, flares, strobes or other strong light sources** (deny access, deny use of landing zones, warn individuals) Electrified barbed wire (deny access) Park vehicles on a runway (deny access, use) Weld access points (deny access) Use of plastic balls (degrade individuals) Use of old vehicles or animals (deny access to vehicles, deny use of landing zones) Dazzle operator (degrade vehicles/vessels)

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List of symbols/abbreviations/acronyms/initialisms

ACO	Allied Command Operations
ACT	Allied Command Transformation
ADT	Active Denial Technology
APC	Armoured Personnel Carrier
CARO	Centre pour Analyse et Recherché Opérationnelle
CBA	Capability-Based Analysis
CF	Canadian Forces
CFD	Chief of Force Development
CORA	Centre for Operational Research and Analysis
DLR	Director of Land Requirements
DND	Department of National Defence
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
GLWD	Green Laser Warning Device
HEMI	High-Energy Muscular Incapacitation
HPM	High-Power Microwave
IED	Improvised Explosive Device
LRAD	Long-Range Acoustic Device
NAAG	NATO Army Armament Group
NATO	North Atlantic Treaty Organization
NGO	Non-Governmental Organization
NLW	Non-Lethal Weapons
POW	Prisoner of War
QRF	Quick Reaction Force
R&D	Research & Development
RF	Radio-Frequency
RPG	Rocket-Propelled Grenade
RTO	Research and Technology Organization
SAS	System Analysis and Studies

SOF	Special Operations Forces
TTP	Techniques, Tactics and Procedures
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
UN	United Nations
US	United States
UV	Ultra-Violet

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To identify CF‟s non-lethal weapons (NLW) requirements and existing capability gaps, Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA) has conducted a non-lethal weapon capability-based analysis (CBA). This work leverages the analysis conducted under the NATO SAS 078 study in which Canada participated. A set of 18 counter-personnel and eight (8) counter-materiel requirements were identified. Since the CF has only nascent NLW capabilities, the identified gaps were significantly greater that the NATO-wide gaps identified by SAS 078. These gaps can be partially mitigated using ad hoc solutions, and partially by the current and programmed NLW capabilities owned by other NATO militaries.

Afin de cerner les besoins des FC en matière d‟armes non létales (ANL) et les lacunes actuelles quant aux capacités, le Centre d‟analyse et de recherche opérationnelle (CARO) de Recherche et développement pour la défense Canada (RDDC) a mené une analyse des capacités liées aux armes non létales. Ce travail met à contribution l‟analyse effectuée dans le cadre de l‟étude SAS 078 de l‟OTAN, à laquelle le Canada a pris part. Une série de 18 besoins antipersonnel et de 8 besoins antimatériel ont été relevés. Étant donné que les capacités des FC en matière d‟ANL ne sont qu‟à l‟état naissant, les lacunes cernées étaient beaucoup plus grandes que celles qui avaient été constatées à la grandeur de l‟OTAN dans l‟analyse SAS 078. Ces lacunes peuvent être atténuées partiellement par l‟emploi de solutions ponctuelles et partiellement par les capacités actuelles et programmées en matière d‟ANL à la disposition d‟autres armées de l‟OTAN.

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