
Submitted by the Chairperson of the Informal Meeting of Experts

1. The 2014 Meeting of the High Contracting Parties to the Convention held on 13 and 14 November 2014 in Geneva decided, as contained in paragraph 36 of its final report (CCW/MSP/2014/9), “to convene under the overall responsibility of the Chairperson an informal meeting of experts of up to five days during the week of 13 to 17 April 2015 to discuss the questions related to emerging technologies in the area of lethal autonomous weapons systems, in the context of the objectives and purposes of the Convention. The Chair of the Meeting of Experts will, under his or her own responsibility, submit a report to the 2015 Meeting of the High Contracting Parties to the Convention, objectively reflecting the discussions held.” Mr. Michael Biontino, Ambassador of Germany, served as the Chair of the Meeting of Experts.

2. The following High Contracting Parties to the Convention participated in the work of the meeting: Albania, Argentina, Australia, Austria, Belarus, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cuba, Cyprus, Czech Republic, Ecuador, El Salvador, Estonia, Finland, France, Georgia, Germany, Greece, Guatemala, Holy See, Honduras, Hungary, India, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kuwait, Lao People’s Democratic Republic, Latvia, Lithuania, Madagascar, Mexico, Mongolia, Morocco, Netherlands, New Zealand, Norway, Pakistan, Palestine, Philippines, Poland, Portugal, Qatar, Republic of Korea, Republic of Moldova, Russian Federation, Saudi Arabia, Serbia, Sierra Leone, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United States of America, Venezuela (Bolivarian Republic of) and Zambia.

3. The following Signatory State to the Convention participated in the work of the meeting: Egypt.

4. The following States not parties to the Convention participated as observers: Algeria, Brunei Darussalam, Cote d’Ivoire, Ghana, Indonesia, Lebanon, Libya, Malaysia, Mozambique, Myanmar, Singapore, Thailand and Yemen.


6. The representatives of the International Committee of the Red Cross (ICRC)
participated in the work of the meeting.


8. The representatives of the following entities also participated in the work of the meeting: Brigham Young University Law School, USA; Centre for Land Warfare Studies, New Delhi; Columbia Law School, USA; European University Institute, Florence; Geneva Centre for Security Policy; Graduate Institute of International and Development Studies, Geneva; Josef Korbel School of International Studies, University of Denver; National University of Ireland, Galway; Peace Research Institute Frankfurt (PRIF); Stockholm International Peace Research Institute (SIPRI); The Harvard Sussex Program (SPRU) University of Sussex; Université de Genève; University of California, Berkeley; University of Central Lancashire; University of Strasbourg; and University of Valenciennes.

9. On Tuesday, 13 April 2015, the meeting was opened by Mr. Ravinath Aryasinha, Ambassador of Sri Lanka, as Chairperson-designate of the 2015 Meeting of the High Contracting Parties to the Convention. The meeting received a video message from the United Nations High Representative for Disarmament Affairs, Ms. Angela Kane.

10. In accordance with its programme of work, as contained in the annex, the Informal Meeting of Experts had interactive exchanges on the following issues: technical issues; characteristics of LAWS; international humanitarian law (IHL); overarching issues and the way forward. The Informal Meeting of Experts commenced with a general exchange of views.

11. Serving as Friends of the Chair were Ms. Yvette Stevens, Ambassador of Sierra Leone, and Mr. Urs Schmid, Ambassador of Switzerland, on technical issues; Ms. Päivi Kairamo, Ambassador of Finland, and Mr. Youngjip Ahn, Ambassador of the Republic of Korea, on characteristics of LAWS; Ms. Zsuzsanna Horvath, Ambassador of Hungary, on possible challenges to IHL due to increasing degrees of autonomy; Ms. Marta Mauras, Ambassador of Chile, and Mr. Ravinatha Aryasinha, Ambassador of Sri Lanka, on overarching issues; and Ms. Filloreta Kodra, Ambassador of Albania, on the way ahead.

12. Each substantive session commenced with kick-off presentations from the following experts:

(a) Technical issues (Part I):

- Mr. Stuart Russel, Professor – Artificial Intelligence: Implications for
Autonomous Weapons;

- Mr. Andrea Omicini, Professor – The Distributed Autonomy: Software Abstractions and Technologies for Autonomous Systems;

- Mr. Paul Scharre – Technical issues related to autonomous weapons systems;

(b) Technical issues (Part II):

- Ms. Elizabeth Quintana – Operational Considerations for LAWS;

- Ms. Heather Roff, Professor – Strategic Doctrines for LAWS;

- Mr. Darren Ansell, Doctor – The Reliability and Vulnerability of Autonomous Systems;

- Mr. Wolfgang Richter, Colonel – Military Rationale for Autonomous Functions in Weapons Systems (AWS);

- Mr. Frédéric Vanderhaegen, Professor – Can dissonances affect the resilience of autonomous systems?;

(c) Characteristics of LAWS (Part I):

- Ms. Maya Brehm – Meaningful human control;

- Mr. Niel Davison, Doctor – Characteristics of autonomous weapon systems;

- Mr. Marcel Dickow, Doctor – Factors for calculating different dimensions of robotic systems that play a role in their autonomous functioning to review political implications for limiting the use of LAWS;

- Mr. Nehal Bhuta, Professor – The notion of meaningful human control and standard-setting for the purposes of monitoring, evaluation and verification;

(d) Characteristics of LAWS (Part II):

- Mr. Pekka Appelqvist, Professor – Systems approach to LAWS: characteristics, considerations and implications;

- Mr. Giovanni Sartor, Professor – Liabilities for autonomous systems in the civil domain;

- Mr. Jason Millar – Meaningful human control and Dual-use technologies; Ms. Sybille Bauer, Doctor;
Ms. Caitriona McLeish, Doctor – Experiences from the CBW regime in dealing with the problem of dual use;

(e) **Possible challenges to IHL due to increasing degrees of autonomy:**

- Mr. William Boothby, Doctor – Article 36, weapons reviews and autonomous weapons;
- Ms. Kathleen Lawand – Some legal challenges under IHL raised by autonomous weapons systems;
- Mr. Eric Talbot Jensen, Doctor – Autonomous weapons systems;

(f) **Overarching issues (Part I):**

- Mr. Christof Heyns, Professor; Ms. Bonnie Docherty – Human rights implications of fully autonomous weapons;
- Ms. Karolina Zawieska – Do robots equal humans? Anthropomorphic terminology in LAWS;
- Mr. Patrick Lin, Professor – The right to life and the Martens Clause;

(g) **Overarching issues (Part II):**

- Ms. Monika Chansoria, Doctor – LAWS: A South Asian Regional Security Perspective;
- Mr. Michael Horowitz, Professor – AWS: Public opinion and international security issues;
- Mr. Jean-Marc Rickli, Doctor – Some considerations of the impact of LAWS on international security: Strategic stability, non-State actors and future prospects;

(h) **The way ahead:**

- Ms. Sarah Knuckey, Professor;
- Mr. Jeroen van den Hoven, Professor;
- Mr. Ian Anthony, Doctor;

**General debate**

13. A great number of delegations took the floor in the general debate, underlining their particular interest in the issue of Lethal Autonomous Weapons Systems (LAWS). Several areas of common understanding emerged from the discussions.
14. The point was made that machines or systems tasked with making fully autonomous decisions on life and death without any human intervention, were they to be developed, would be in breach of international humanitarian law, unethical and to possibly even pose a risk to humanity itself.

15. A number of delegations stressed that such systems do not currently exist and several delegations expressed that their states had no intention of developing weapons systems of that nature.

16. Delegations expressed their appreciation for the discussions within the framework of the Convention on Certain Conventional Weapons (CCW). With a wide range of experts for military perspectives, international law and humanitarian issues, the CCW could guarantee a balance between humanitarian concerns and security aspects. Some delegations underlined the need for a fact-based discussion. Other delegations added that the human rights aspects of the issue should be adequately taken into account CW might not be the only appropriate framework for discussion on LAWS.

17. The imperative for unconditional respect for international law, in particular for international humanitarian law (IHL) and international human rights law was an area of universal appreciation. Delegations expressed their expectation for an uncompromising willingness to implement IHL irrespective of the nature of a weapon or weapons system. Important elements of IHL mentioned included an unequivocal accountability chain in the deployment of a weapons system, the respect of the principle of distinction and proportionality as well as the precaution imperative.

18. Many states saw LAWS as fundamentally opposing the basic principles of IHL and called for an immediate, legally binding instrument providing for a ban of LAWS which would encompass their development, acquisition, trade and deployment. LAWS would not be able to apply basic requirements like proportionality or distinction due to the complexity of the considerations leading to target engagement decisions. The fear that LAWS could fundamentally change the nature of war was expressed. Arguments also included the assessment that LAWS were unethical by nature because they lack judgment and compassion, that the existence of LAWS would increase the risk of covert operations and intentional breaches of IHL that it would exacerbate asymmetric warfare and lead to impunity due to the impossibility of attribution. Moreover, the concern was raised that once LAWS came into existence they would generate new risks of proliferation and could lead to new forms of arms races. They could challenge regional balances and possibly global strategic stability as well as affect general progress on disarmament and non-proliferation. Moreover, LAWS could lower the threshold for starting or escalating military activity. Finally, LAWS could fall into the hands of non-state actors and increase the risk and potential of terrorism.

19. However, most delegations expressed the view that it was early to draw far-reaching conclusions as the subject of the discussions needed further clarification. Some delegations saw the debate as being only at an early stage, with the need for the development of further common understanding. The term "meaningful human control" was raised frequently as a possible notion furthering the understanding of the nature of
LAWS. However, some delegations saw a need for further debate on this notion, or preferred the term “autonomy”. Other delegations highlighted the concept of “critical functions” as potentially helpful in finding defining elements for LAWS. Some delegations also made a distinction between automated and autonomous systems. It was pointed out by some delegations that existing systems were not a subject of the LAWS debate.

20. Many delegations underlined the dual-use character of the underlying technology necessary for the development of LAWS and stressed the benefits of autonomous technologies in the civilian world. The important contributions to the understanding of the technical and legal challenges posed by LAWS made by civil society organisations, the industry, researchers and scientific organisations was also mentioned.

21. It was generally recognised that the debate needed to be taken forward. Several proposals were mentioned in this regard, including the decision to hold another Informal Meeting of Experts, a mandate for the establishment of a Group of Governmental Experts and the call for an immediate ban on LAWS. Enhancing transparency as a trust-building measure was mentioned by several delegations, including in the assessment of the compliance of new weapons systems with IHL. Specifically, procedures for a weapons review process according to Article 36 of Additional Protocol I of the Geneva Convention were mentioned as a possible area for enhanced transparency.

22. The ICRC pointed out that consideration of existing systems with autonomous functions may give an indication of possible risks and an adequate understanding of the expected developments in autonomous functions of weapons systems. Representatives of civil society organisations pointed to a perceived disconnect between the declarations of many States expressing their intention to refrain from acquiring LAWS whilst pursuing the development of further autonomous functions in weapons systems. They called for enhanced transparency and a more ambitious mandate as a next step in the debate. While some organisations called for rigorous definitions, others argued that, at this stage of the debate, an adequate framework for regulations should take priority over definitions.

Technical issues (Part I)

23. The high contracting parties followed presentations by academic experts on autonomous systems of artificial intelligence, the notion of distributed autonomy and the state of research and expected further developments in autonomous systems.

24. Points made in the expert presentations included:

(a) Artificial intelligence

(i) The underlining of very rapid progress made in the area of artificial intelligence (AI) in recent years, due to increasing data processing capacity, increased industry research and an overarching theoretical framework.
(ii) In several areas, including face recognition, flight navigation or in tactical video-games, autonomous systems and computers already exceed human performance today. The number of such areas is bound to increase rapidly. Humans may soon be largely defenceless against artificial systems and that physical limits (energy, speed, range, payload) rather than computational shortcomings will be the inhibiting retarding factor in the development of LAWS.

(iii) Challenges are posed by uncertainty, including limited information, uncertainty over the outcome of actions and open-universe uncertainty ("unknown unknowns"), limiting the predictability of a system.

(iv) Attention should be paid to the potential destabilising momentum of emerging technologies.

(b) Distributed autonomy

(i) Talking about autonomous systems mostly means talking about software systems and components.

(ii) Complex computational systems are modelled as multi-agent systems. Agents can be human or software by nature; their defining feature is autonomy. Each autonomous agent pursues its own goal. Autonomy as such is finally modelled as the distributed property of socio-technical systems.

(iii) Autonomy is therefore distributed among agents (and agent societies). In the same vein, decision making, responsibility and liability are distributed.

(iv) Attributable responsibility requires engineering discipline and norms.

(c) State of play and expectations

(i) The notion of autonomy has several dimensions:

- Degree of human control – in the loop, on the loop, out of the loop;

- Degree of “intelligence” – a continuous spectrum between automated and fully autonomous machines and systems;

- Nature of the task – from a small element within an operation up to an overarching goal.

(ii) Reasons for taking humans out of the loop may include speed requirements, communication disruption, need for self-defence, fear of states of being “left behind”.

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(iii) The challenge of IHL compliance may be averted by using LAWS in an adequate environment – like underwater or in outer space.

(iv) Risk posed by autonomous systems interacting with superhuman speed: Unforeseen behaviour like the “flash crash” seen on the NYSE on 6 May 2010 calls for the need for provisions avoiding a “flash war” (circuit breaks).

25. In the discussion, experts were asked for support in finding an adequate definition for autonomy – a task that could be successfully carried out according to experts taking into account relevant AI principles. It was indicated that there is a trade-off between the intelligence of software and the possibility of controlling its behaviour. The anticipated reluctance of military commanders to open up to transparency was by some mentioned as an obstacle to imposing engineering discipline and transparency. However, the legitimate security concerns of States was noted, which must be balanced against transparency needs. Distrust regarding the possibility of making software resistant to unintended consequences in fast interactions was expressed by some. Civil society organisations articulated the concern that the design of LAWS for areas without IHL challenges (e.g. underwater, air, outer space) may pave the way for legalisation of LAWS.

26. Experts mentioned that autonomous functions could also be introduced into the cyber sphere and used there for the application of force. Finally, it was argued by some that technical progress in autonomous systems is extremely fast, the window of opportunity for regulating these systems would close rapidly.

Technical Issues (Part II)

27. The second part of the panel on technical issues focused on understanding the military rationale behind the development of increasingly autonomous functions and technologies. Presentations were given on Operational Considerations for LAWS, Strategic Doctrine and Tactical Rationale for the deployment of LAWS. A second part of the presentations and discussions was devoted to the issues of reliability, resilience and vulnerability of LAWS, touching on the manageability of complex systems.

28. Points made within the framework of the presentations included:

(a) Operational considerations for LAWS

(i) The security environment today is characterised by diverse threats, an increasingly globalised defence industry, dominance of the civilian sector in research and development and increasing vulnerability to cyber-attacks.

(ii) Increasing speed, rising costs of military personnel, the ability to intervene in areas difficult to access and the need to keep up with possible adversaries in terms of technology were described as possible reasons for military interest in autonomous functions.
(iii) At the same time, weariness of fully autonomous systems on the side of the military is due to the difficulties to assess the liability of commanders, the danger of autonomous systems falling into the hands of the adversary, the risk of an arms race and a possible lowering of the threshold for engaging in military intervention.

(iv) Political oversight of the military always requires meaningful human control and many layers of scrutiny already exist.

(b) **Strategic doctrine**

(i) Historically, autonomous functions were developed to compensate for numeric weakness and to enhance capabilities in air, land and sea environments. Today, the driving force has shifted to replacement of personnel in labour intensive or dangerous tasks.

(ii) The rationale for enhanced autonomous functions is different with regard to aerial, naval and land systems.

(iii) Aerial systems are being developed in view of enhanced endurance and to bundle intelligence, surveillance, reconnaissance and the capability to strike together, albeit remaining as distinct capabilities. Impediments to this approach include public distrust and intense political scrutiny, high costs of development and operation, obstacles to interoperability, vulnerability and unpredictability.

(iv) In naval environments, limitations in communication and increasing areas and distances in surveillance tasks are rationales for the development of autonomous systems. Naval LAWS would pose new challenges to maritime law and would encounter testing and verification problems in a complex environment.

(v) Land systems are being developed for countermine actions, defensive artillery and support systems for other entities. Ground systems pose particular concerns regarding compliance with IHL as military objectives and targets evolve dynamically.

(vi) In armed conflict, tactical considerations will require systems to be small, durable, distributable and stealthy.

(vii) These developments could lead to an increased risk of arms races and proliferation, as smaller systems are more easily acquired by non-state actors.

(viii) In insurgency conflicts, the increased distance between the operator and the target would present particular risks of inappropriate military action.
(c) Tactical considerations in the use of LAWS

(i) Generally speaking, autonomous weapons systems are designed to increase survivability of own forces, and to achieve goals with higher precision, fewer forces and less risk for civilians.

(ii) Degrees of autonomy in weapons have been present for decades, including automatic munitions (e.g. landmines), precision-guided munitions, target identification and tracking, automated target selection and engagement against incoming missiles.

(iii) The use of autonomous weapons is not equal to tactical autonomy. Complex battlefield situations involve the need for coordinated and combined use of fire, movements, reconnaissance, quick and effective delivery of weapons, foreseeing redundancies, etc. LAWS could only be used to carry out specific elements and not to replace tactical command and control functions.

(iv) Autonomous weapons systems are and will be under the control of commanders responsible for selecting specific targets or target categories, specifying the area and time of activity and designing the operation against the requirements of the situational context in compliance with IHL.

(d) Reliability and vulnerability of autonomous systems

As operating failures in LAWS could result in catastrophic consequences, LAWS would have to be engineered to the highest level of accuracy, reducing programming errors including false requirements, incorrect algorithms, inadequate testing or incorrect use of the software. In this regard strict adherence to existing industrial standards (DO-178C) was recommended.

29. In the discussion, the risk of LAWS affecting stability and arms control was raised by some. As a particular aspect, the risk of LAWS prolonging hostilities longer than necessary was mentioned. It was however pointed out that the risk of arms races was not specific to LAWS. Possible measures to counter these dangers could include additional transparency – e.g. publishing procedures in implementing obligations according to Article 36 of Additional Protocol I to the Geneva Conventions, an agreement on a code of conduct or new arms control agreements taking into account new technologies. Moreover, the possible usefulness of sharing standards for testing and deployment was mentioned. It was also reiterated by some that autonomous systems could not replace humans at the tactical, operational or strategic headquarters level, but would rather supplement certain functions in technical levels of operations. Some mentioned that the general trend towards weapons increasingly capable of discrimination might contribute a higher degree of protection for civilian populations.
30. Social context was also mentioned as an element influencing the judgement of the potential use of LAWS. Concern was expressed regarding the risks emanating from reduced human interaction and communication between adversaries by the use of LAWS. Several delegations pointed to lethality as the crucial property which implies the necessity for regulations and raises the core ethical concern regarding the transfer of life-and-death decisions to machines. The unpredictability of machine behaviour within self-learning systems, in particular in an unknown environment was mentioned. The point was made that the lack of determinism and the complexity of the systems would make comprehensive testing difficult if not impossible. In that context, the importance of limiting the operation of LAWS in time and space was mentioned by some as a possible solution. Moreover, the possibility of a self-destructing mechanism was raised. A reason for self-destruction could be the hijacking of a system by the adversary or the malfunction of a system.

31. Other delegations underlined the usefulness of autonomy for the implementation of important military functions like mine clearance, rescue operations and the protection of civilians. LAWS could enhance the precision of strikes and thus reduce collateral damage. However, a rigorous evaluation was to be carried out, not only in the moment of the acquisition but over the whole life cycle, including through testing, the effective adaptation to changing circumstances and the verification of full and effective respect of IHL at all times.

Characteristics of LAWS (Part I)

32. In the absence of an agreed definition of LAWS, achieving more clarity on the basic features that distinguish a LAWS from other weapons systems was seen as the way to better understand these systems and determine whether they would breach international humanitarian law.

33. The discussion mainly focused on the notions of “autonomy” and “meaningful human control” as possible benchmarks for furthering the understanding of LAWS, placing limits on their use and ensuring their compliance with international law.

34. Points made in the expert presentations included:

(a) **Meaningful human control**

(i) A key issue in relation to this notion is the interaction between a human being and weapon technologies that have the capacity to function independently. The aim is to identify the best ways to regulate the evolution of these technologies and, if necessary, place constraints on their use.

(ii) There seems to be a widespread understanding that both the legal and ethical acceptability of a weapon system would require some kind of human control. However, the exact nature of this control is still unclear.

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(iii) Control can be exercised in multiple ways, e.g. through the management of resources. Control does not have to be absolute. Human control is generally exercised in determining when, where and how force is applied.

(iv) As a first step, one may focus on what type of control is not considered meaningful. This might include systems operating over extended periods of time with no possibility of human intervention or supervision.

(v) The notion of 'meaningful human control' is more a way to structure the debate than a means to define autonomy. It should serve as a way to identify parameters for LAWS that would make them legal and acceptable.

(b) Multidimensional definition of robotic autonomy (MAD)

(i) In contrast to political approaches to autonomy, a techno-centric approach was suggested with the aim of defining a level of autonomy as well as calculating and benchmarking the various dimensions of a robotic system that play a role with regard to its autonomous functioning. Possible advantages of such an approach include calculability, reproducibility, verifiability, transparency and negotiability.

(ii) A definition of the autonomy of LAWS should take into account all factors that contribute to it, leading to a multidimensional autonomy definition. The different factors which should be examined in this regard are physical (time, space, energy), sensors (quality, quantity, impact) weapons (quality, quantity, impact), human control (steering, veto) and machine (errors, fault, tolerance, self-preservation).

(c) Critical functions

(i) In the search for defining elements of LAWS, it may be useful to focus on "critical functions", defined as the ability of a machine to select and engage a target. This focus on autonomous use of force is more fruitful than an analysis of the technical sophistication of the weapon. Moreover, unlike the critical functions, the technical sophistication is not relevant to the ethical and legal considerations concerning an autonomous weapons system.

(ii) Further factors to be considered are the level of human supervision, the nature of the target (object, human), the complexity of the environment and the predictability and reliability of the weapon.

(iii) Consequently, further reflection is needed on how the context can affect human supervision with regard to the critical functions.
Policy implications

(i) Existing international law and IHL provide the appropriate normative framework for the evaluation of the legality of LAWS.

(ii) In the LAWS debate, meaningful human control is suggested as a both technical and normative standard. Meaningful human control could be made an explicit requirement in IHL, leaving its determination open to further elaboration and standard setting.

(iii) Standards are an important tool to specify the requirements of norms. For example, while Article 36 of Additional Protocol I of the Geneva Convention constitutes an important norm, its effectiveness can only be ensured if further specifying standards in relation to LAWS are defined.

(iv) Standards could also constitute an important tool for transparency.

35. The following discussion focused primarily on the notion of “meaningful human control” and how this emerging concept could be useful to effectively address the potential risks associated with LAWS. Different views were expressed regarding the usefulness and advantages of the notion of meaningful human control when addressing LAWS.

36. Several states expressed scepticism over the added value of the suggested concept, assessing it as being too vague, subjective and unclear. In particular, some delegations upheld that when characterising LAWS, “autonomy” would be a more precise and appropriate technical term. Furthermore, the inherent paradox between the defining element of autonomy in LAWS and the focus on human control requiring a restriction of this autonomy was pointed out. In response, it was reiterated that autonomous functions were evolving step-by-step and that total and full autonomy as such could be considered a fundamentally theoretical notion with no practical implications. Other delegations pointed to the possible useful contribution of the term of meaningful human control to assess the requirements for compliance with IHL. However, it was understood that the term is to be seen as an ethical rather than a legal assessment. Several states reiterated they did not possess LAWS and had no intention of acquiring them.

37. The concept of predictability was also referred to as helpful in addressing the development of weapon systems, especially when it comes to self-learning capacities.

38. Other issues raised included how to address the accountability gap LAWS seem to create; the developments in automation and the consequent evolving intelligent partnership between operators and technical systems.

39. It was underlined that ultimately, states were the responsible actors in the development, acquisition and deployment of any weapon system, including LAWS and faced the need to comply with the requirements of Article 36 Additional Protocol I to the Geneva Convention. An informal mechanism to exchange best practices on national legal
weapons reviews was suggested as well as the creation of an independent body to supervise how the standards are applied.

Characteristics of LAWS (Part II)

40. The second part of the panel on the characteristics of LAWS dealt with the dual-use characteristic of autonomous technology. The term “dual-use” refers to the fact that the underlying technology can be used for civilian as well as military purposes. Experts explained their concept of a system approach to LAWS as applied to other civilian systems operating in networks, legal provisions regulating autonomous functions in the civilian sphere and the study of export control regimes regarding other dual-use products.

41. Points made in the framework of the expert presentations included:

(a) Systems approach to LAWS

(i) LAWS should be considered as complex network systems, allowing for the understanding of stochastic behaviour, non-linear dynamics or unpredicted features associated with LAWS. The discussion should avoid too narrow a focus on specific platforms.

(ii) The complexity of the battlefield means that networks integrating LAWS and surrounding infrastructure in a Command, Control, Communication, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR-)System with distributed functions in the network can provide advantages. This makes the boundaries of LAWS ambiguous and the localisation of the decision making process difficult.

(iii) Cognitive features of the system including memory association as well as learning and problem-solving are essential for a system to be considered autonomous.

(iv) Due to fast evolving technology and the civilian applications of autonomous functions, possible regulations should focus on generic principles in the development, deployment and operation of LAWS.

(b) Legal framework for civilian autonomous systems

(i) Autonomous systems in the civilian domain including transport, medical applications or rescue operations are subject to national legal provisions. A distinction is made between criminal law provisions and civil liability.

(ii) Criminal offences arising from misuse of autonomous systems including intentional misbehaviour, recklessness or negligence could be dealt with in a similar manner to other offences not involving autonomous systems.

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(iii) There might be cases when criminal prosecution fails due to the impossibility of unambiguously attributing blame for the offence. If the social benefits (e.g. overall reduced accidents with autonomous cars) outweigh the social costs then this may be an acceptable problem.

(iv) Personal civil liability in case of an offence could be treated similarly to a criminal offence. In the case of civil liability without fault, liability gaps may occur but can be bridged by legal instruments like strict liability (e.g. for agents or animals), compulsory insurance or producer compensation (e.g. by car manufacturers).

(v) However, in military contexts liability concepts will pose new challenges. The lack of prosecution possibilities with regard to criminal liability cannot easily be weighed against social benefits.

(c) **Challenges to meaningful human control (MHC)**

(i) The idea of MHC is a specifically human element, guaranteeing ethical and moral value in the decision-making process.

(ii) However, human decision-making is far from being able to provide a consistent reference for ethical values. Even simple and seemingly unrelated alterations of circumstances (e.g. surrounding noise) can substantially change most people’s behavioural patterns.

(iii) The apparent paradox that human control is vulnerable and prone to bias or faulty decision making should not lead to the conclusion that decision making should be delegated to machines. It rather suggests that special care has to be taken when designing man-machine interfaces in order to avoid distorting the human intention. This could be particularly pertinent because bias in decision making could reinforce itself in a chain of subsequent instructions to elements of the system.

(d) **Nature of dual-use export control regimes**

(i) Examples for export control regimes for dual-use goods are provided by the Chemical Weapons Convention (CWC) and the Biological and Toxin Weapons Convention (BTWC). UNSCR 1540 aims to deny non-state actors and terrorists access to weapons of mass destruction.

(ii) The crucial question faced by these regimes is how to suppress illicit weapons development without hindering trade and technological development for peaceful purposes.

(iii) The CWC and BTWC focus on purposes, not on specific substances or technologies (“general purpose criteria”). Controls are based on the end user or the end use.
(iv) Rapidly evolving technologies do not trigger the need for the treaty to be adapted, and peaceful activities can continue unhindered.

(v) Industrial cooperation proved to be necessary for the creation of an effective verification regime including declarations and on-site inspections.

42. An important part of the discussion continued to focus on the notion of meaningful human control. Some delegations reiterated their doubt regarding the adequacy of this notion. The focus on a narrow definition of MHC would not ensure safeguards against unintended consequences. Instead, the adequacy of the relationship between humans and machines was identified as the core question. The term of human judgment was proposed as an alternative. Further discussions were seen as necessary. As a special case of the vulnerability of human control to external influence, the alteration of human behaviour under duress (e.g. in the battlefield) was mentioned.

43. Regarding dual-use items, the question was raised of whether a discussion on export control regimes for LAWS was premature, as there was still no definition of LAWS, let alone a common understanding whether LAWS should be subjected to regulation. The concern was raised that control regimes may pose an obstacle to legitimate technology transfer. Moreover, as there was still a lack of definition, it was as yet unclear whether characterisation as “conventional” weapons was premature.

44. In response, it was stressed that the presentation of the mechanisms of the CWC and BTWC regimes and the principle of General Purpose Criteria should only serve as an example of how control regimes could be implemented without harming industrial and peaceful development. Thus, they were precisely designed not to hinder legitimate technology transfer. Experts also pointed to a shift in acceptability of technology denial for terrorist organisations, furthered by UNSCR 1540 (2004).

Possible challenges to international humanitarian law due to increasing degrees of autonomy

45. Building on the 2014 Meeting of Experts, this year's session on IHL provided a more in-depth examination of the challenges posed by LAWS in terms of compliance with IHL, targeting rules with regard to LAWS and the guarantee of accountability and legal responsibility in relation to LAWS.

46. In the expert presentations the following points were made:

(a) Legal weapons reviews

(i) States Parties to Additional Protocol I of the Geneva Convention (AP I) are subject to the regulations of Article 36 which provides for a legal weapons review in the case of the study, development, acquisition or adoption of a new weapon, means or method of warfare, ensuring compliance with applicable international law. States not party to AP I are
subject to the obligation of a review of new weapons under international customary law.

(ii) A concern when reviewing LAWS is how such systems could apply targeting rules at least as accurately as a human. Questions include whether the system could assess anticipated military advantage, expected collateral damage or whether collateral damage may be deemed excessive. When engaging humans, the system should be able to distinguish combatants from civilians, and able-bodied combatants from those hors de combat.

(iii) Systems deployed in an offensive manner choosing their own targets would most probably fail a legal weapon review under current technologies. However, technology may evolve and meet the requirements in the future.

(iv) Meaningful human control may be useful as a policy approach to address shortcomings in current technology. However, it should not be applied as a legal criterion as this could undermine existing targeting law by introducing ambiguity. Instead, a rigorous application of the weapon review duties in good faith by states in particular with regard to the targeting rule would be the best guarantee of adequate protection of civilians and civilian objects.

(b) Is there a need for additional regulation?

(i) Autonomy should be seen as a characteristic of technology attached to a weapons system, not the weapon itself. LAWS is therefore an “umbrella term” covering a wide range of weapons systems.

(ii) Conformity of autonomous weapons with IHL will depend on the specific type of weapon and on circumstances including the type of the task, context of its use, type of target, type of force, freedom of movement, geographical area and timeframe of the action.

(iii) Increasing autonomy and complexity of the weapon make outcomes less predictable. However, predictability is crucial in order to assess conformity with IHL. Deploying a weapons system with unpredictable effects creates a significant risk of a breach of IHL.

(iv) At the operational stage, a commander would have to fully understand the capabilities of the autonomous system as he has to make a judgment about the appropriate amount of risk in the deployment.

(v) A rigorous weapons review is therefore needed. A significant challenge is how to test LAWS as part of a legal weapons review process, in particular, how to test predictability. The ICRC encourages states to
establish a mechanism for a review process and stands ready to advise states in this regard.

(c) IHL regarding emerging technologies

(i) New weapons technologies always give rise to discussion on the ability of the law to properly regulate the technology in question. With regard to earlier emerging technologies like balloons, submarines and early aircraft, different attempts were made to prohibit new weapons or to impose a temporary ban on them. However, these attempts did not withstand the onslaught of war.

(ii) It may be deemed more prudent to allow the development of technologies whilst ensuring that they are developed in compliance with existing law.

(iii) Autonomous technologies could lead to more discriminating weapons systems. It may therefore be premature to prohibit LAWS on the basis of the current shortcomings in autonomous technologies.

(iv) At the point at which weapons systems are thinking for themselves rather than following instructions from human commanders (i.e. equipped with artificial intelligence) the legal situation would need to be reconsidered.

47. In the following discussion, several delegations reiterated their unwillingness to delegate decisions concerning life and death to an autonomous system. For some delegations the targeting rules were best assessed and applied by humans. However, it was also mentioned that this was an ethical rather than legal assessment.

48. There was wide support for encouraging the implementation of legal weapons reviews and the need for all states to ensure that new weapons systems would be used in compliance with IHL. The point was made that by applying IHL to LAWS they might prematurely be legitimized.

49. Experts underlined that the review process would have to be implemented in good faith, including the consideration of the intended use. Several delegations consequently explained elements of their national review process. Moreover, the proposal was made that, as a trust building measure, states could share their legal weapons review procedures with other CCW States Parties and a number of delegations saw value in sharing best practices and lessons learnt from legal weapons reviews within the CCW. Some states expressed their view that the legal weapons review process was sufficient with dealing with concerns over LAWS.

50. However, a number of concerns and questions were raised in this respect. Legal weapons reviews would have to assess the lawfulness of a LAWS and its capability to implement the targeting rules. Doubts were expressed over the necessary experience and the technical and scientific capacity to effectively implement a review process and in
particular to thoroughly test LAWS. It was noted that legal weapons reviews, being subject to national procedures without further international supervision, could not necessarily be a sufficient instrument to build trust and confidence. There were questions about how these review processes operated in practice and whether weapons systems were ever rejected in the course of the review. Further concerns were raised regarding different states inevitably applying different standards within these processes.

51. There were differing views on whether it would be possible to hold a human accountable for the actions of a LAWS. It was argued that current military chains of command could ensure accountability. Training, proper instructions and rules of engagement would also assist in avoiding the misuse of autonomous systems. There were calls for further work to be done in order to guarantee the accountability chain.

52. A proposal for the development of standards specific to LAWS and a new normative framework was made. Calls for the prohibition of LAWS referred to the example of Protocol IV of the CCW regarding the prohibition of blinding laser weapons. However, other delegations argued that the prohibition of LAWS without a clear understanding of potential opportunities and risks of the technology could deprive the world of beneficial new technologies.

Overarching issues (Part I)
Human Rights and Ethical Issues

53. The first part of the session on overarching issues was dedicated to ethical and human rights questions. The panellists included experts on international law and human rights as well as academics on philosophy and computer science.

54. The following points were made by experts during the presentations:

(a) Human Rights

(i) Human rights and ethics have been prominent in the debate on LAWS which gained momentum with the report of the Human Rights Council’s Special Rapporteur on Summary and extrajudicial killings. Although the CCW mandate is dedicated to IHL, there are reasons why discussion on LAWS should not be limited to IHL but may also include international human rights law.

(ii) The underlying issue in the discussion about LAWS is the increased use of processing power by computers in the determination of a decision to use force against humans. A holistic approach is needed including situations in armed conflict as well as in law enforcement, and lethal and non-lethal use of force.

(iii) The use of LAWS potentially affects the right to life, the right to bodily integrity, the right to human dignity, the right to humane treatment and the right to remedy. As the principle underlying all other rights, the right to dignity is fundamental.
(iv) Even if a machine would be able to comply with IHL requirements, doubts remain whether lethal decisions made by a machine are ethical. Autonomously taken decisions over life and death would affect the dignity of the person targeted. It would also affect the dignity of the principal on whose behalf the killing takes place — States, governments, societies. Even if LAWS would be accurate enough to spare lives in comparison with actions of human soldiers, the dignity of those targeted would still be affected.

(v) In law enforcement, applied force is allowed only when it is necessary and proportional as a means of last resort. LAWS would not be able to cope with these requirements.

(vi) A condition for remedy to violations in the use of force is individual accountability. The accountability gap inherent to LAWS lead to violations of International Human Rights Laws. Following these considerations, LAWS should be banned.

(b) Right to life and Martens Clause

(i) The right to life can be reframed as right to dignity. While the concept of dignity remains vague and a lack of human dignity is not equal to illegality, the Martens Clause can expand our understanding of human dignity.

(ii) With regards to LAWS, challenges regarding accountability and remedy and, most importantly, the lack of possible human reflection on a life-and-death decision may affect dignity.

(iii) However, soldiers are most of the time are not required to reflect on the gravity of their action. On the other hand, moral reflection could be located in the design and programming of LAWS.

(iv) To refer to the Martens Clause, a weapon would have to be deemed *mala in se* which requires further thought. In particular, anthropomorhization, attributing human characteristics to a weapon, should be avoided.

(v) The notions of “right to life”, “right to dignity” and the Marten’s Clause have to be sharpened in order to provide practical guidance.

(c) Anthropomorphic approach

(i) Robots are often designed to have human characteristics, but they are not human. However, people anthropomorphize nonhuman objects in all cultures and societies.
(ii) The projection of human characteristics leads to confusion and misguided expectations. This also affects misleading terminology, including terms like “autonomy”, “intelligence”, “decision making”, “morality”, “self-awareness”.

(iii) Anthropomorphization of LAWS leads to a misleading framework of interpretation and the projection of a human on a machine. It also bears the risk of dehumanizing human beings by equalizing them to objects and reducing them to single characteristics.

(iv) A new framework of accountability would be required particularly using a more adequate terminology (“artificial autonomy”, “robotic autonomy”, “artificial agents” etc.) to accurately describe the state of robotics and stress the difference between humans and human-like.

(v) This would return to a human-centred approach and make obvious that the only subject for the use of weapons are human beings.

55. In the subsequent discussion two divergent points of view emerged regarding the ethical and legal framework. The first one opposed universal moral and ethical values to anticipated capacities of LAWS and principally doubted the morality of delegating to a machine the decision to kill a human. Proponents insisted that legal and ethical questions arise not only in conflict situations. Therefore, besides IHL, international human rights law was to be considered. Moreover, pure legal considerations might not be sufficient, hence the call for a pre-emptive ban on the basis of ethical considerations was the logical consequence.

56. The other side recommended caution against premature conclusions while the nature of LAWS was still unclear and neither possible risks nor possible benefits could be assessed on a solid basis. In this current situation a focus on the legal requisites seemed prudent. While there were no explicit legal limitations on autonomy in weapon systems, focusing on compliance with IHL and, in the case of the use of LAWS for law enforcement purposes, on the compliance with international human rights law, would be the appropriate course.

57. In order to ensure respect to applicable law, a national legal weapon review pursuant to Art. 36 of the Additional Protocol I would be recommended. It was also emphasized that the legally prohibited should not be confused with the morally undesirable as this would entail ambiguity and the weakening of IHL. However, it was also noted that national legal review processes pave the way for considering methods to make more uniform its application in all States, while respecting national law and customs.

58. The discussion also brought to light differing views on the inherent nature of LAWS. Some delegates deemed the concept of an independent intelligent agent,
eventually even possibly getting out of the control of its human creator, as a possible outcome.

59. Others insisted that machines would always be mere tools — although sophisticated ones — in the hand of humans. Concepts like self-awareness could not be reproduced in machines as they were even far from being understood regarding humans. In this context, meaningful human control would need further and thorough reflection. The assumption that machines would make life-and-death decision was erroneous as commanders, operators, programmers and engineers were responsible for the decision to use force. Based on the assumptions that advances in technology will occur incrementally in time, the attention was also drawn to the possible evolution of the relationship between humans and machines today. The next generation might have another approach with regards to accepting technology, possibly including LAWS.

60. Furthermore, the assessment of the significance of the Martens’ Clause in the context of LAWS was controversial. The concept of “the laws of humanity and the dictates of the public conscience” were considered as rather vague and only applicable in case no other norm to regulate a given situation could be found. For some participants, the emergence of LAWS would therefore either imply the need for a legally binding instrument like a ban, or the call for the application of the Martens Clause in face of the legal vacuum created by the new situation due to LAWS. For others, no legal vacuum exists as IHL does not forbid autonomy as such, but would provide a means of regulating its possible use. However, for many experts and delegations, the supreme right to life and human dignity is the legal and ethical umbrella to continue these discussions.

61. Concerns were expressed by several delegations regarding the further shift in power in favour of rich countries and the increased vulnerability of poor countries due to the development of LAWS. The risk of an arms race would deter important resources which otherwise could be used for the benefit of development and urgent social and economic tasks.

62. Finally, in view of the close links between human rights law and IHL in respect to LAWS, a closer cooperation between the Human Rights Council and the CCW in this specific question was recommended by some of the delegations. Recommendations also concerned the encouragement of further public debate and involvement of civil society, academia and other competent bodies.

Overarching issues (Part II)

General security

63. The second part of the session on overarching issues was dedicated to general security issues, including strategic implications for regional and global stability, new forms of arms races, new asymmetries and the lowering of the threshold to apply force.
Points made in the Expert presentations included:

(a) Regional Security Perspective

(i) Technology plays a critical role as an enabler and enhancer of force and may be useful for a variety of security roles.

(ii) The example of UAVs shows that in the use of lethal technology the ability for distinction would be paramount. Lethal functions should be considered with care and proper regulation.

(iii) The application of lethal force by UAVs should be regulated rather than banned. As the context is mainly given by urban asymmetric situations, in case of the use of lethal technology the ability for distinction would be paramount. Lethal functions should be considered with care and proper regulation.

(b) Autonomous Weapon Systems: Public opinion and security issues

(i) Referring to the Martens Clause, a number of actors claim that LAWS violate the “dictates of public conscience”. As the “public conscience” is a far reaching notion, the benchmark for clear evidence would have to be supported by a forceful, unambiguous and widespread public understanding.

(ii) While public opinion cannot be equated with the public conscience, it might be perceived as a relevant indicator. Some have supported their claims with research indicating public discomfort with such technologies.

(iii) However, there is evidence that results of surveys heavily depend on the applied methodology. A complex and widely unfamiliar subject like LAWS suggests that questions should be embedded in a relevant context. A survey respecting this premise suggests that the public opinion in the USA is inconclusive on LAWS as a majority deemed the use of LAWS preferable to exposing the own military at risk. Moreover, a low level of opposition for the development of LAWS for defensive purposes could be shown.

(iv) However, more research would be necessary in order to substantiate the results.

(b) Impact of LAWS on international security: strategic stability, non-state actors and future prospects:

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(i) Strategic stability refers to the condition that exists when potential adversaries recognize that neither of them would gain an advantage if they were to begin a conflict with the other. An advantage over the adversary in defensive action increases, in offensive action reduces stability.

(ii) By their assumed capabilities, LAWS would enhance the dominance of the offensive. This has a range of consequences: The strategic advantage in the ability to strike first would imply that the best defensive strategy would be the pre-emptive offensive strike. This would lower the threshold for the use of force and increase the probability of an arms race.

(iii) Moreover, LAWS would be attractive to non-state actors, enabling them to create shock and awe, to use them as a force multiplier, and to spare their own fighters.

(iv) Already today, current technology that can be acquired off the shelf could serve as the basis for the development of drones carrying explosives. The international community should be careful when considering the development of LAWS that could exacerbate the terrorist threat.

65. In the following discussion the usefulness of considering experience from UAVs in the context of LAWS was questioned. On the other hand, the assertion was made that consequences of the deployment of LAWS for affected populations could be assumed to be similar to those due to remotely controlled or semi-autonomous weapons systems.

66. The relevance of the presented surveys was questioned by some delegations, in particular the point of view of those being affected by LAWS should be studied; and those already having been at the receiving end of armed UAVs provide important insights. Otherwise we would merely be judging whether unaffected people would merely be preferring use of machines rather than human beings for combat purposes.

67. The absence of an agreed definition would also curtail the value of this research. There was agreement that more research was necessary to gather clearer evidence in order to inform the LAWS debate and offer support to future strategies.

68. Many interventions supported the notion that LAWS may lower the threshold for the use of force and that there is a risk of abuse by non-state actors. A more defensive design of a LAWS could still be reprogrammed as to serve offensive purposes. Moreover, the development of LAWS could accentuate asymmetric warfare, characterized by increased insurgency and reprisal measures including the risk of escalation of conflict.
In this perspective, meaningful human control requires a mechanism through which decisions are implemented in line with moral and practical imperatives.

To ensure the compliance of IHL and International Human Rights Law, systems have to be designed in advance allowing for control by including transparency and verifiability on different relevant system levels.

In the discussions, several delegations expressed their concern whether it may be premature to discuss transparency measures at the present stage. They underlined that the debate showed still substantially diverging views. Moreover, there was not yet a clear understanding of the definition of LAWS, and no international binding instrument to regulate LAWS, implying the lack of a basis for the implementation of transparency measures. Skepticism was also expressed regarding the willingness of states to share information that would possibly touch upon commercially sensitive data. These delegations upheld that further discussion and work was necessary before engaging on a transparency debate.

Other delegations supported the idea of transparency in the field of autonomous systems, and made concrete proposals for a possible implementation, including the publication of national procedures of the review process according to Art. 36 AP I, introducing control on international transfer of autonomous technology in order to prevent their proliferation and misuse by non-state actors, establishing a set of Best Practices, establishing national Points of Contact and share information as widely as possible.

Way Forward

Regarding the possible way forward, there was a general understanding that the debate needs further deepening. Delegations supported the idea that the CCW was the right forum for a continuation of the discussions, with some delegations indicating that other fora could complement the CCW debate.

Regarding the next step in implementing such a continued discussion, differing views were expressed. Some parties saw the need for a continued informal and generalized discussion, as a more formalized approach would require the identification of broader common ground. These delegations favored a renewed mandate for an Informal Meeting of Experts to be convened in 2016 and to be decided at the High Contracting Parties meeting in November 2015. Some delegations stressed that the continuation of the debate should not be construed as a legitimation of LAWS.
75. Other delegations expressed their willingness to take the process a step further and signaled support for a more concrete mandate, specifying the issues to be considered in detail. Issues that were mentioned included an in-depth examination of Art. 36 AP I obligations, a discussion on the general acceptability of LAWS in reference to the Martens Clause, ethical issues and the notions of meaningful human control, critical function, autonomy, command and control, and system-human interaction. Delegations made different proposals as to the appropriate formal framework of such a specified mandate. Several delegations proposed the establishment of a Group of Governmental Experts. However, delegations also showed openness for a continued more informal framework.