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Ceasefire Monitoring and Verification Technology

Ceasefire negotiators, monitors, and verifiers should not ignore advances in technology. What technology can and cannot do, however, has to be carefully assessed in relation to other factors that make or break a ceasefire.

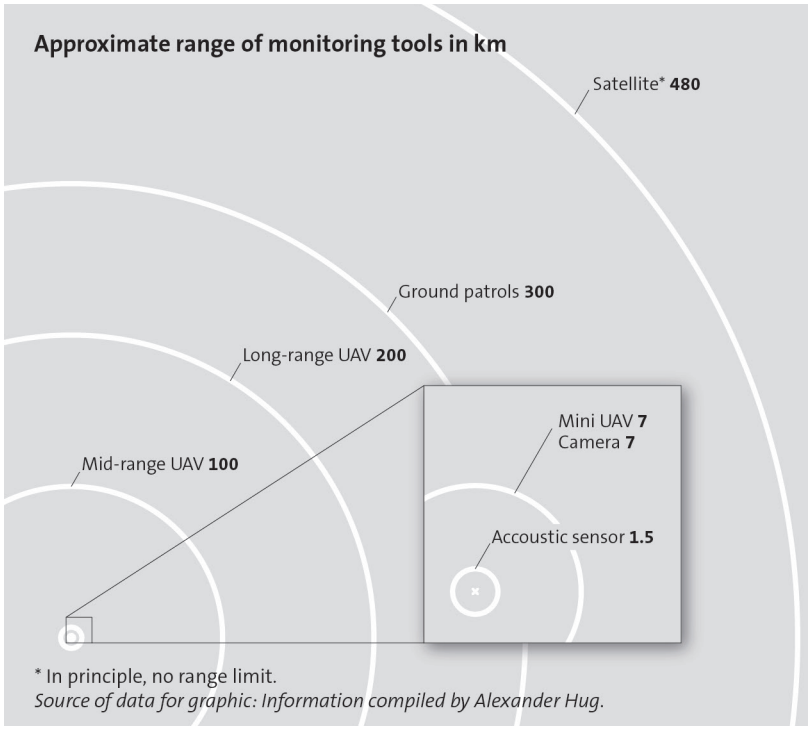
By Alexander Hug and Simon J. A. Mason

The best ceasefire agreement along with a monitoring and verification mission will not stop a ceasefire from collapsing in situations where conflict parties believe they can gain their political objectives better through military means rather than through negotiations with the other side. Yet there are other situations where a lack of clarity in the ceasefire agreement and insufficient monitoring and verification of the ceasefire lead to misunderstandings and dynamics of escalation. The quality of the ceasefire agreement is key, and technology can assist.

Technology can assist the accurate observation of reality (monitoring) and establish empirically whether ceasefire measures are being implemented as agreed (verification). Its use can help humans collect high-quality data around the clock and in areas that are difficult or inaccessible. It reduces certain costs and security risks. Technology can complement the work of human observers. Yet humans will always be needed to make sense of the data generated by technology – even if they may also be increasingly

Key Points

- Ceasefires fail for different reasons, one of them being the poor quality of ceasefire agreements and their insufficient monitoring and verification.
- The use of technology for ceasefire monitoring – such as drones, cameras, acoustic sensors, and satellite imagery – can reduce the costs, minimize the security risks for humans, and improve the quality of ceasefire monitoring and verification through better area access and unbiased, high-quality data.
- For technology to effectively assist monitoring and verification, a politically supported and detailed ceasefire agreement needs to be in place. To build trust, conflict parties need to be involved in joint monitoring, verification, and compliance mechanisms, where necessary with the support of a third party. This requires clarity regarding the respective tasks of human monitors and verifiers on the one hand, and technological systems on the other hand, with the latter having a complementing role.
- To make use of the potential of technology for ceasefires and to minimize risks, states and international governmental organizations need to invest in training experts, acquiring the necessary infrastructure, and developing and coordinating the appropriate processes.



supported in this task through technology such as AI. However, technology cannot replace direct contact between observers and the parties to the conflict, as well as affected civilians respectively, which is crucial to build trust in the monitoring and verification mechanism.

A preliminary ceasefire agreement normally specifies how the military forces will stop firing, withdraw weapons, disengage, and how this is monitored and verified. A definitive ceasefire may also include clauses on disarmament, demobilization, and the cantonment of forces and equipment, and how this is monitored and verified. The ceasefire agreement thereby regulates the ceasefire monitoring or verification task.

Types of Technology

Technological systems for ceasefire monitoring include drones, cameras, satellites, and acoustic sensors. These are systems that can also be used at night when combined with the right sensor technology.

Drones: Short-, medium- and long-range drones can fulfill different needs. Long-range drones with a range of 200 kilometers or more can be equipped to carry the required payload (e.g. a camera, infrared sensor, or radar). However, they are expensive (e.g. USD 1 million per drone or more) and complex to operate often requiring external, expert operators. Smaller drones can be operated by human patrols themselves and do not require professional pilots or maintenance. Because of their ease of use, they are particularly effective in overcoming restrictions on movement, mainly passive restrictions (e.g. unexploded ordnance and landmines), but sometimes active ones (intentional blocking by conflict parties), and in accessing areas to which human patrols do not have access. Yet, the limited range of human patrols may also place operating officers closer to the "hot area" to be observed and thus might make them a target. The ability to identify potential risks in the immediate environment, including the patrol route as such, greatly improves the patrol's situational awareness and safety. In addition, smaller drones are less costly than a long-range drone.

Cameras: A permanent physical presence of observers is often not possible due to the security situation. Surveillance cameras can therefore be installed in many hotspots as well as in areas to which the forces have retreated; in designated places where withdrawn weapons are stored; areas of disengagement and at key points such as crossings of demarcation and front lines or near key civilian infrastructure. This allows monitoring of a given area from a safe distance around the clock.

Satellites: The satellites orbit the earth in a regular path and are able to photograph the same area of land each time they pass over. This – as with images taken by unmanned aerial vehicles (UAVs) and cameras – enables analysts to detect changes on the battlefield over time, particularly in relation to the positions of armed forces, damage to essential infrastructure, the presence of weapons systems and other military installations, designated places with withdrawn weapons, and areas of retreat. In certain circumstances, satellite imagery analysis also enables the determination of the direction of fire through assessment of the impact crater. It also provides human patrols with additional situational awareness that can be useful in their planning.

Radar and acoustic sensors: Cameras, drones, and satellite imagery are visual sources. To expand surveillance capabilities, additional sensors that detect and analyze the specific acoustic signature of a fired weapon system (e.g. rifle fire, muzzle blast, incoming artillery, or mortar explosions) can be deployed. Acoustic sensors consist of microphones that can register battle sounds in different directions, triangulate the origin and direction of fire, and under certain circumstances determine the type of weapon being used.

A single type of technology is neither sufficient to cover large and diverse geographical areas nor to capture the various aspects of the ceasefire agreement. Best results are achieved through a combination of different types of technology. Factors to consider include, inter alia, the range of observation tools (see figure), cost of technology, ease of

deployment and maintenance by human patrols or other experts, quality, quantity and timing of information needed, data transmission, data security, perception by local populations and parties to the conflict, and adaptability to conflict dynamics.

Information Management

The collection, analysis, interpretation, securing, and communication of data generated by technology are challenging, and require different levels of organizational activities: first, direct data collection. Sometimes an operational unit at the field level is needed to coordinate field activities and control and manage field data collection. It plans and dispatches patrols to collect information and maintain the technology in use. Human patrols may also directly observe and verify themselves physically (e.g. with a binocular or other handheld devices or small UAVs), identify areas of interest (e.g. where they cannot patrol), and follow-up on identified issues and violations. Nevertheless, some information gathering does not require permanent field presence, e.g. data collection from satellites, cameras (if the feed is transmitted to a central hub), acoustic/radar sensors, or long-range UAVs.

Secondly, an organizational set-up is needed to analyze, disseminate, and archive the data collected. Field teams need to be able to have access to and do initial analysis of the data of small-range UAVs, not least for their situational awareness. A higher-up coordination mechanism may be needed to compare and consolidate these data, avoid double counting, and store information securely. Data security is key to alleviate concerns by conflict parties that information is not being tampered with or "leaked" to actors who are not meant to access it. This is vital as such information might reveal positions of weapons systems and could be used as targeting information. Months or even years of video footage and a growing number of images require sophisticated and safe archiving tools and large storage space. A searchable database allows a monitoring mission to identify trends over time. Violations of an agreement are not always visible by the human eye on patrol. Only by comparing the situation over time can violations such as new trenches be revealed.

Third, there is the task of translating and interpreting the collected data into an accessible and digestible format. This involves interpretations and summaries of all the information produced. The target audiences, e.g. conflict parties or wider public, and periodicity of communication (on an incident basis, daily, weekly, monthly) need to be assessed. This communication and reporting set-up serves as a decision support tool for a monitoring mission, to inform the conflict parties and the public about progress in the ceasefire implementation. It may also serve as a necessary basis for humanitarian efforts.

The use of technology is only as good as the systems put in place to process the vast amounts of information. This can be personnel intensive. The interplay between human patrols and technology is key and directly affects the quality of the information obtained and operational flexibility of the human patrols.

Benefits and Risks

The benefits and risks of technology for ceasefire monitoring and verification are related to the purpose and type of ceasefire. Early on in a peace process, simple technology systems may help in monitoring short-term humanitarian ceasefires or temporary pauses in fighting. As the will to negotiate increases in a peace process, preliminary ceasefires may then be part of a political settlement process, stopping the violence and opening up space for political talks. Definitive ceasefires, finally, end the status of war. More complex and robust monitoring and verification systems make sense for preliminary and definitive ceasefires. Ceasefires, however, may also help contain violence for a period of time, rather than being integrally linked to a political negotiation process aiming to address the underlying causes of the armed conflict or end the status of war. Technology may play a role in such "containment" ceasefires, but it requires an even more careful assessment of the involved risks compared to ceasefires that are more clearly linked to a viable political negotiation process.

In sum, technology can reduce the security risks and costs of both observation and, to a lesser extent, verification missions and offset some of the constraints on movement and access of human patrols. More territory can be covered with fewer personnel. Information collected is generally of high quality and is less likely to be contested by conflict actors if the actors trust the systems. Technology can also support confidence-building and joint fact-finding by parties, encourage dialogue between them, and provide an incentive and opportunity to work together, e.g. on the technology-assisted delivery of humanitarian aid. Combined with an effective political agreement process and a clear ceasefire agreement, technology can be an effective deterrent, as it can increase the detection rate of violations.

The use of technology can also have the opposite effect, however. If not all parties agree to aspects of its deployment, such as its framework, management, and the processes

Further Reading

Govinda Clayton et al., **"Ceasefires in Intra-state Peace Processes,"** *CSS Analyses in Security Policy* 252 (2019).

Jeremy Brickhill, **"Mediating Security Arrangements in Peace Processes: Critical Perspectives from the Field,"** *CSS Mediation Resources* (2018).

it involves, it can fuel mistrust, lead to finger-pointing between actors (e.g. by using the data produced by technology), and even escalate the conflict. In addition, much of the available technology is expensive to procure and difficult to install, operate, and maintain in an active conflict zone – even if it is cheaper than only relying on human patrols. In addition, technology generates large amounts of data that require additional resources to collect, process, analyze, use, and secure. There are also physical limitations to the use of the technology. Given weather-related limitations and possible interference by the conflict parties (intentionally to avoid violation detection or unintentionally as they try to "jam" each other and the monitoring technology simply stands in between) and the sensitivity of some technologies, the limits of their use become all too clear.

Most importantly, the collection of facts with technology must have a purpose and seek to make the ceasefire more stable and progress to peace irreversible (e.g. by feeding a ceasefire commission with relevant data). If the purpose of data is not clear, it is more likely to be abused by conflict parties – e.g. in a "containment" ceasefire. Thus, the use of technology cannot compensate for the shortcomings of imperfect agreements, the lack of an accountability mechanism, or a lack of political will. Political will is needed on two levels: first, at the level of the parties to the conflict; and, second, at the level of third parties. The use of technology is not likely to be effective if third parties are mainly using it to avoid putting boots on the ground or camouflage the absence of will to address the root causes of a conflict ("fig leaf" argument).

Preparation and Expertise

Well-thought-out preparation helps ensure the effective use of technology. First, it is important to consider the *political processes* and the context that shapes a ceasefire. Second, clarity of the ceasefire agreement and ensuing *mandate* for monitoring and/or verification is needed. Third, the actual *situation in the field* needs to be mapped, including geography, types of weapons used, location of military forces, and location of civil society and critical infrastructure. Fourth, a *market analysis* of the available technology is necessary, mapping the evolution of new options and changing costs. Fifth, technology is increasingly being used in different monitoring missions around the world. Hence, *learning* from other cases helps avoid mistakes and improve the use of technology. Sixth, the *risks* involved in the use of ceasefire monitoring and their mitigation need to be explored. Seventh, a monitoring mission's *administrative requirements and funding resources* need to be examined, also assessing and potentially adapting internal processes and data management.

To exploit the benefits of technology for the observation of ceasefires, trained experts, available means of deployment, suitable organizational structures, and well-coordinated procedures are required. The benefits of technology are only sustainable if the personnel deployed are able to recognize the technical aspects of the implementation of a ceasefire and situate them in relation with the political, military, and humanitarian consequences.

Expertise to collect and process the volumes of data is needed. However, experts need not only technical know-how, but also a basic understanding of the goals and functions of ceasefires in peace processes. In order to harness the potential of technology for ceasefire monitoring and to minimize its risks, member states of the United Nations, the OSCE, and other regional organizations need to invest in the appropriate technology as well as in the training, selection, and supervision of experts.

The link between technology and peacemaking is already a reality. The question is whether states will invest in the sustainability and enhancement of this link, thereby improving the chances for peace – or at least the containment of conflict.

Alexander Hug was the Principal Deputy Chief Monitor of the OSCE Special Monitoring Mission to Ukraine (SMM) from the establishment of the SMM in early 2014 until the end of 2018. The views expressed are those of the author and not those of any of the institutions mentioned.

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