

# Russia's war against Ukraine: Lessons on infrastructure security and new technologies

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## INTRODUCTION

In 2022, Russia hit Ukraine with a major cyberattack and unleashed a full-scale war of aggression. This includes new technologies<sup>1</sup> and AI-enabled capabilities such as the Bylina electronic-warfare command-and-control system.<sup>2</sup> Nord Stream<sup>3</sup> and the Balticconnector<sup>4</sup> also fell victim to sabotage attacks by hostile actors. The EU has stepped up the resilience and cybersecurity of critical infrastructure. However, the capacity to leverage innovative technologies and defensive AI remains underdeveloped. Worrying is also the fact that protection of industrial control systems (ICS)<sup>5</sup> remains unaddressed. As Russia upgrades<sup>6</sup> its 2030 National AI Development Strategy,<sup>7</sup> there is an urgency to integrate the security of industrial controls into the EU's approach to the cybersecurity of critical infrastructure, before Moscow strikes with deadlier offensives. It is also time to start building a measured, albeit scalable, deployment plan for new technologies that may be AI-enabled for European critical infrastructure in connectivity with Ukraine and Moldova.

## BACKGROUND: RUSSIA'S CYBER-MILITARY THREAT

While the world was focused on the 200,000 Russian troops on the Ukrainian border, on 23 February 2022, Russia hit Ukraine with some of the most impactful cyberattacks<sup>8</sup> to date. They rendered much of Ukraine's infrastructure inoperative, deactivated the US satellite provider<sup>9</sup> (Viasat Inc's KA-SAT) used by Ukraine's military, and spilled over into Germany, France, Poland, Hungary, Greece, and Italy.<sup>10</sup> A day later, Russia began a full-scale ground invasion, including airstrikes. The integration of

cyber capabilities into Russia's military strategy aimed to facilitate the military takeover by destabilising Ukraine internally and cutting it off externally.

Even though the cyberattacks did not provide the expected military advantage, it created significant damage and revealed Russia's expanding capabilities. This may be used elsewhere, for example, against Moldova and Georgia ahead of national elections in autumn 2024.<sup>11</sup> It also exposed the unpreparedness of the West and gave a sense of urgency to bolster cybersecurity. After all, neither Ukrainian nor Euro-Atlantic state security structures deterred the attack. In response to Kyiv's request, the EU activated the cyber rapid-response team<sup>12</sup> (CRRT) to assist Ukraine, and cyber non-profits such as the IT Army of Ukraine consisting of 300,000 international volunteers also helped.<sup>13</sup> But to a high degree it was the US technology companies who provided the tools that allowed Ukraine to defend itself from the Russian cyberattack.<sup>14</sup> The reliance on volunteers, and foreign private entities based 10,000 kilometers away, reflects a worrying state of European cybersecurity and a shortage of experts.

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## Russia's AI strategy

Russia's threat must be understood in the context of Moscow's AI strategy, which started with President Vladimir Putin's 2017 statement that whoever dominates AI "will rule the world".<sup>15</sup> Russia's first 10-point military AI initiative<sup>16</sup> and National AI Development Strategy<sup>17</sup> followed in 2018-19 through 2030 led by Sberbank (financing sector), Rostec (military sector) and Gazprom Neft (oil/gas sector). In 2023, Putin announced its review:<sup>18</sup> He highlighted generative AI, partnerships build-up, and a need to counterbalance Western algorithms, which Putin called "monopolistic" and "biased."

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Despite these priorities, Russia's innovation capabilities remain limited, ranking 51/132 according to the Global Innovation Index 2023.<sup>19</sup> But Moscow does not need to be among the world's top 10 tech giants to launch a lethal attack.<sup>20</sup> It has developed and employed advanced technologies against Ukraine through unmanned vehicles, robotics and, electronic weapons such as AI-enabled Bylina.<sup>21</sup> Russia is also deepening cybersecurity cooperation with Tehran,<sup>22</sup> Beijing<sup>23</sup> and Pyongyang,<sup>24</sup> which demonstrates their alignment in opposition to the West. Thus far, cyberattacks on the infrastructure of the EU and NATO have not been attributed to the axis of Russia, China, Iran, and the Democratic People's Republic of Korea (DPRK). Still there should be no surprise if their cooperation in cybersecurity through combined training and technology transfer became more menacing.

## STATE OF PLAY: CATCHING UP ON CYBERSECURITY BUT MISSING OUT ON AI

Russia's cyber capabilities highlight the need for better preparedness and robust measures in the Euro-Atlantic area. The EU is starting to catch up, but the approach remains slow and haphazard.

The EU started with achievable goals: the expansion<sup>25</sup> of the EU's NIS2 to public administration, space, and electronic communication networks. As well as the obligation to establish a registry for entities providing cross-border services by the European Union Agency for Cybersecurity (ENISA) to help speed up and coordinate the EU's response to large scale cyber-attacks.<sup>26</sup> The Directive on the Resilience of Critical

Entities<sup>27</sup> is also welcome because it sets some ground rules for all member states. Such rules relate to the requirement to carry out risk assessments on a regular basis and the development of national strategies for the cybersecurity of critical infrastructure. The Directive also foresees additional support to the entities who provide services to six or more member states. This is a vital step in mitigating the effects of large-scale cyberattacks with cross-border dimensions.

In addition, the political agreement reached<sup>28</sup> in March 2024 on the EU Cyber Solidarity Act<sup>29</sup> (Act) provides the EU with new capabilities (European Cybersecurity Shield, Alert System, Emergency Mechanism and Incident Review Mechanism) to detect, prepare and respond to cyberattacks across the EU. However, this development has four significant shortcomings:

- ▶ **The Act would be more effective if it foresaw scenarios of worst-case attacks on infrastructure as well as procedures to deal with liability in situations where, for example, important data was lost, and the neighbouring country's network was also damaged.** Moreover, reducing the time needed to detect a large cyberattack from 190 days to a few hours will be a struggle unless the EU adopts significantly higher cybersecurity measures. Indeed, the provision for the EU Cybersecurity Reserve aims to support the Cyber Emergency Mechanism by creating a list of reliable providers who can respond to major cyberattacks or incidents in the EU. This provision promotes stronger collaboration between the public and private sectors. However, there are some shortcomings in the nature of the reserve. There are no provisions regarding the reserve's size, diversity, or accountability, nor are there attack scenarios. If the provider does not meet the expectations, the Act fails to specify if another provider would intervene.<sup>30</sup>
- ▶ **Ukraine and Moldova are not associated with the reserve nor with the Act given that they do not have cybersecurity enshrined as a strategic objective within the Digital Europe Programme (DEP). A lack of coordination with NATO is also problematic.** Associating and including Ukraine and Moldova would provide a substantial safeguard for the Euro-Atlantic security considering that Russia's attacks on Ukraine can spill over into the territory of the EU and NATO. For example, in the Baltic States, Denmark, and beyond.<sup>32</sup> Moreover, Russia may attack a non-NATO member of the EU and spill over into the shared EU-NATO area without directly attacking NATO. This is pertinent given the rising number of cyberattacks since Russia's invasion of Ukraine. In 2022, the Google Threat Analysis Group<sup>33</sup> counted over a 300% increase of Russian-state-backed cyberattacks in NATO countries. In Ukraine,<sup>34</sup> 4,748 cyber incidents happened in 2022-2023, of which 1,415 were "major or critical." The Russia-Ukraine cyberwar is projected to be "even harder"<sup>35</sup> in 2024 and beyond, while the global cost of cybercrime may triple by 2027.<sup>36</sup> In this regard, both the EU and NATO would benefit if the Act incorporated channels of coordination and consultation.

► **The third shortcoming of the Act is related to Establishing the European Cybersecurity Shield.** Using cutting-edge technologies such as AI to detect cyber threats through National and Cross-Border Security Operations (SOCs) will enhance intelligence sharing and real-time situational awareness among the member states.<sup>37</sup> In this regard, the deployment of EU pilots for 2024-2026, such as cyber consortiums ATHENA<sup>38</sup> or ENSOC<sup>39</sup> carry the potential for enhanced cross-border coordination among the selected member states. However, the aim of creating an AI-assisted pan-European network of cyber hubs is based on aspiration.<sup>40</sup> The national and cross-border cyber-hubs are non-mandatory, do not cover critical infrastructure and do not include Ukraine or Moldova. Small and regional steps using advanced technologies including AI should not be discounted. However, the proposed approach is not so much the creation of a shield or a network as a fragmented cybersecurity landscape with some countries being better protected than others. For any of this to have a “network effect” across the EU, it would also be important that the proposed cross-border consortiums are interoperable with each other.

► **The Act (and the wider EU’s approach to cybersecurity) does not consider protecting the industrial control systems of critical infrastructure.** This is despite evidence that cyberattacks are shifting towards industrial controls (ICs) and away from the more typical IT-related databases.<sup>41</sup> This is important, because ICs are the key vulnerabilities in critical infrastructure due to their monitoring and physical control processes. According to Industrial Cybersecurity Consultant Vytautas Butrimas<sup>42</sup> and Lecturer on hybrid threats, resilience, and global strategy Chris Kremidas-Courtney,<sup>43</sup> there is a need to fundamentally change the approach to the security of critical infrastructure by incorporating the protection of industrial controls.

The EU should mandate member states and invite neighbouring countries to participate in at least one AI-assisted cross-border cyber hub and SOC, in close coordination with NATO. The EU pilots from 2024-2026 must create synergies with NATO’s exercises such as the Cyber Coalition 2022 event<sup>44</sup> (NATO’s flagship annual collective cyber defence exercise) and Exercise Dynamic Messenger 23, which have already tested the ability of emerging technologies and AI to protect critical infrastructure.<sup>45</sup> The scope of these exercises should also be extended to include the industrial control defences, Ukraine and Moldova, to maximise standardisation, interoperability and minimise vulnerabilities. Furthermore, findings should be leveraged to design mature and stable specifications for advanced technologies and defensive AI, and feed into the EU-NATO Taskforce on critical infrastructure.<sup>46</sup> NATO’s undersea infrastructure cell,<sup>47</sup> and relevant agreements with third countries such as in the scope of the European Network of Transmission System Operators for Electricity (ENTSO-E).<sup>48</sup>

## A deployment plan for new and AI-enabled technologies

AI presents threats and opportunities which the EU and NATO must factor into their approach to infrastructure security. AI can enable cyberattacks to become more targeted and sophisticated through phishing emails, malware or deepfakes of unprecedented quality. It could also be developed to find vulnerabilities in a victim’s infrastructure and attack - known as offensive AI. While offensive AI’s speedy, accessible and evasive nature, which supersedes conventional security systems,<sup>49</sup> can be counteracted by new technologies enabled by defensive AI. Therefore it is important that the EU work with NATO to move from aspiration to action and start developing stable and mature specifications for new and AI-enabled technologies. Based on those specifications, they should build a measured, albeit scalable, deployment plan along the critical European infrastructure networks. This needs to be done selectively yet speedily before offensive AI becomes ever more mainstream, while simultaneously continuing to research and test breakthrough technologies and future AI.

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The deployment plan should be developed step by step, with indicative deadlines for its implementation and select as priority several segments of critical infrastructure that are suitable for early deployment (phase 1); based on lessons learned, the plan should progressively extend (phase 2) to those infrastructure segments that connect to phase 1, to turn the segments of infrastructure into a connected network. The connectivity with the infrastructure segments of neighboring countries (phase 3) such as Ukraine and Moldova should also be considered.

As the threatened landscape evolves such an approach requires continuous research, testing and understanding of innovative technologies including how AI could enable defenses against cyberattacks and sabotage. **The following examples illustrate which new technologies could be potentially applied and standardised for early deployment on critical infrastructure in the EU and NATO:**

► **In 2022, Nord Stream, a gas pipeline running from Russia to Germany under the Baltic Sea, was sabotaged by a bomb.**<sup>50</sup> To counter such attacks, technologies including underwater sensors could be

deployed for early warning. Autonomous Underwater Vehicles (AUVs) could also be used to mitigate and prevent sabotage by moving, monitoring, analysing data, pre-warning, and enhancing decision-making 24/7. AUVs can also jam signals. NATO has already tested the viability of AUVs on undersea infrastructure through a series of multi-domain exercises in Portugal.<sup>51</sup>

- ▶ **In 2023, the Balticconnector, the EU's first gas interconnector<sup>52</sup> between Finland and Estonia, was damaged by an anchor.<sup>53</sup>** Seismometers and acoustic sensors such as distributed acoustic sensors (DAS) could be deployed to monitor, analyse, share data, and pre-warn about seabed activity 24/7. The new technology of DAS is advantageous because it suits linear infrastructure such as long pipelines in a high-density environment.<sup>54</sup> In this regard, lessons can also be drawn from wildlife conservation in sub-Saharan Africa, which relies on the technologies of underwater robots and microcontroller sensors to send notifications about any threats and risks to the environment.<sup>55</sup> Moreover, since the Balticconnector was damaged by a private company, legal and financial measures such as financial fines and barring of the private company from European ports could also serve as a deterrent measure.<sup>56</sup>
- ▶ **Telecommunications and electricity grids can be powered by advanced technologies and AI monitoring 24/7, which could detect thousands of failed log-in guesses and prompt defensive measures before it is too late.** Moreover, quantum sensing and quantum encryption technologies carry enormous potential<sup>57</sup> both to enhance threat detection and risk analysis and to protect critical infrastructures even from the most sophisticated cyberattacks.

## PROSPECTS: ENHANCING CRITICAL INFRASTRUCTURE SECURITY

The EU has strengthened cybersecurity and resilience of critical infrastructure. However, there is scope for improvement. Considering the pace at which new technologies and AI-enabled technologies are developing, the following steps would enhance the security of European infrastructure:

**1: Possible attack scenarios.** Consideration of the size, diversity and the liability of EU Cybersecurity Reserve would make the Cyber Emergency Mechanism more resilient, while the development of possible attack scenarios, including the worst possible case, would increase the readiness and response of the emergency mechanism itself.

**2: Mandatory SOCs and cyber hubs.** The Union should mandate member states and invite neighbouring countries such as Ukraine and Moldova to participate in at least one SOC and AI-assisted cross-border cyber hub proposed in the scope of the EU Cyber Solidarity Act to create a “network effect” across the EU.

**3: Industrial control systems (ICS).** Considering the shift of cyberattacks towards ICS and away from more traditional IT databases and communications, the EU must integrate the security of industrial control systems into its cybersecurity approach to critical infrastructure.

**4: Synergies between the EU and NATO.** The EU and NATO should seek synergies in the scope of pilots and exercises dedicated to testing the ability of emerging and AI-enabled technologies to enhance situational awareness and protect critical infrastructure. The pilots and exercises should also cover the defences of industrial controls, include Ukraine, Moldova and relevant agreements with third countries such as in the scope of ENTSO-E. Findings and lessons learned should be leveraged to develop mature and stable technical specifications for innovative technologies and defensive AI.

**5: A deployment plan for new technologies that may include AI.** The EU and NATO should progressively build a measured albeit scalable deployment plan for innovative technologies that may be AI-enabled along the critical European infrastructure networks and connect to Ukraine and Moldova. The process should be developed in phases and select as a priority several segments of critical infrastructure that are suitable for early deployment. The development of stable and mature specifications would help ensure that the deployment plan is scalable and interoperable.

The Euro-Atlantic cybersecurity landscape is only as strong as its weakest link. Russia will continue flexing cyber-military offensives until Putin meets his goals in Ukraine and beyond. Considering that Norwegian,<sup>58</sup> Swedish,<sup>59</sup> German,<sup>60</sup> Polish,<sup>61</sup> and British<sup>62</sup> authorities do not exclude an attack on EU and NATO countries before 2030, the EU must enhance the cybersecurity of critical European infrastructure through the protection of industrial control systems, joint pilots and exercises with NATO, and progressively build a measured yet scalable deployment plan for new technologies in connectivity with Ukraine and Moldova.

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