Atlantic Council
SCOWCROFT CENTER
FOR STRATEGY AND SECURITY

ISSUE BRIEF

Troubled Vision:

Understanding recent Israeli-Iranian offensive cyber exchanges

JULY 2020 JD WORK AND RICHARD HARKNETT

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EXECUTIVE SUMMARY

Reported Iranian intrusions against Israeli critical infrastructure networks and alleged Israeli actions against Iranian proliferation-associated targets pose substantial new challenges to understanding ongoing competition and conflict in the Middle East. These cyber exchanges may be interpreted through two distinct lenses: as the struggle to achieve deterrence using the instrument of cyber operations, or as the contest for initiative in order to establish conditions for relative security advantage in a cyber-persistent environment. Either way, these ongoing incidents are best understood not as "bolt out of the blue" attacks, but rather fleeting glimpses of continuing cyber campaigns leveraging previously disclosed and newly developed capabilities as each side grapples to anticipate cyber vulnerability and shape the conditions of exploitation. The opaque nature of these interactions is further complicated by potential bureaucratic politics and interservice rivalries, as well as unknown dynamics of a counter-proliferation campaign to slow, disrupt and potentially destroy Iranian nuclear capacity. In the end, observed cyber actions may not represent reflections of accurate strategic calculation, and even if aligned to the operational environment they may not lead to intended outcomes. Continuous failure to deter, or inability to manage persistent interactions, may lead to greater dangers.

INTRODUCTION

Iran and Israel are allegedly engaged in cyber operations against each other.[1] Two key questions emerge. The core question is whether these operations have a deliberately pursued end state that reasonably follows from their actions. The secondary question is: if pursued, can this end state be achieved? There are two prominent end states that might explain these cyber interactions:

1. Each side is attempting to establish and re-establish credible deterrent red lines to persuade the other side to cease and desist;

2. Each side is trying to gain initiative within and through cyberspace to establish the conditions for relative security advantage—to gain some modicum of control in a fluid environment of cyber persistence.

The analysis presented in this issue brief suggests that efforts to establish red lines are likely to fail and potentially lead to a spiral escalation. Gaining initiative through cyber operations for security advantage is a relatively uncharted form of militarized competition that could stabilize, but if handled poorly, also escalate a conflict.

At a macro level, these cyber interactions sit within the larger statecraft conducted by both countries as regional rivals. It is not clear, however, that what we are glimpsing is the simple introduction of an additional means (cyber) to that statecraft. It is important to consider how the operational interplay in, from, and through cyberspace may take a life unto itself. Importantly, this issue brief introduces the analytical lens that suggests that there is strategic value in contesting each other in cyberspace that itself becomes a new form of and context for competing statecraft. Cyberspace may be vital enough that what Israel and Iran are engaged in is advancing their broad rivalry with cyber means, while simultaneously contesting "control" over this vital new terrain itself. Thus, there are both new means and new ends driving behavior.

Alleged disruptive cyber attack at Bandar Abbas

In early May 2020, networks supporting shipping and cargo handling operations within the Iranian port of Shahid Rajaei at Bandar Abbas allegedly suffered disruptions following a cyber intrusion.[2] No technical reporting regarding the incident has been disclosed to date. The state-owned Rajaei facility has remained one of the country's key logistics hubs, handling over 85 percent of Iranian import-export cargos.[3] Although downplayed by the Iranian Ports and Maritime Organization, satellite imagery showed continued disruption suggesting extensive delays at the container terminals' eight vehicle entry and exit lanes.[4]

Western and Israeli media reporting has linked this incident to offensive action by the government of Israel, allegedly in direct response to an attempted Iranian intrusion in late April 2020 against multiple Israeli water utility networks. These alleged Iranian attacks sought to alter industrial control systems in a manner that may have been intended to create lethal effects.[5] The alleged water treatment attack could also have been operational preparation of the environment for action timed as part of annual campaigns associated with Qods Day. While this date typically sees attempted intrusions and disruptive attacks from multiple ideologically motivated actors, in prior years these attempts have usually had only limited or merely symbolic impact.[6] This year's effort likely assumed greater importance due to multiple pressures on the Iranian regime, including

1 The need to use of the term "allegedly" says a lot about the cyber operational space—not only about its potential clandestine and covert nature, but how states can exploit the ambiguity itself to advance interests, including allowing narratives to build in the media about real and potential non-existent cyber operations. This analysis relies on authors' access to industry intelligence assessments and open-source reporting only.

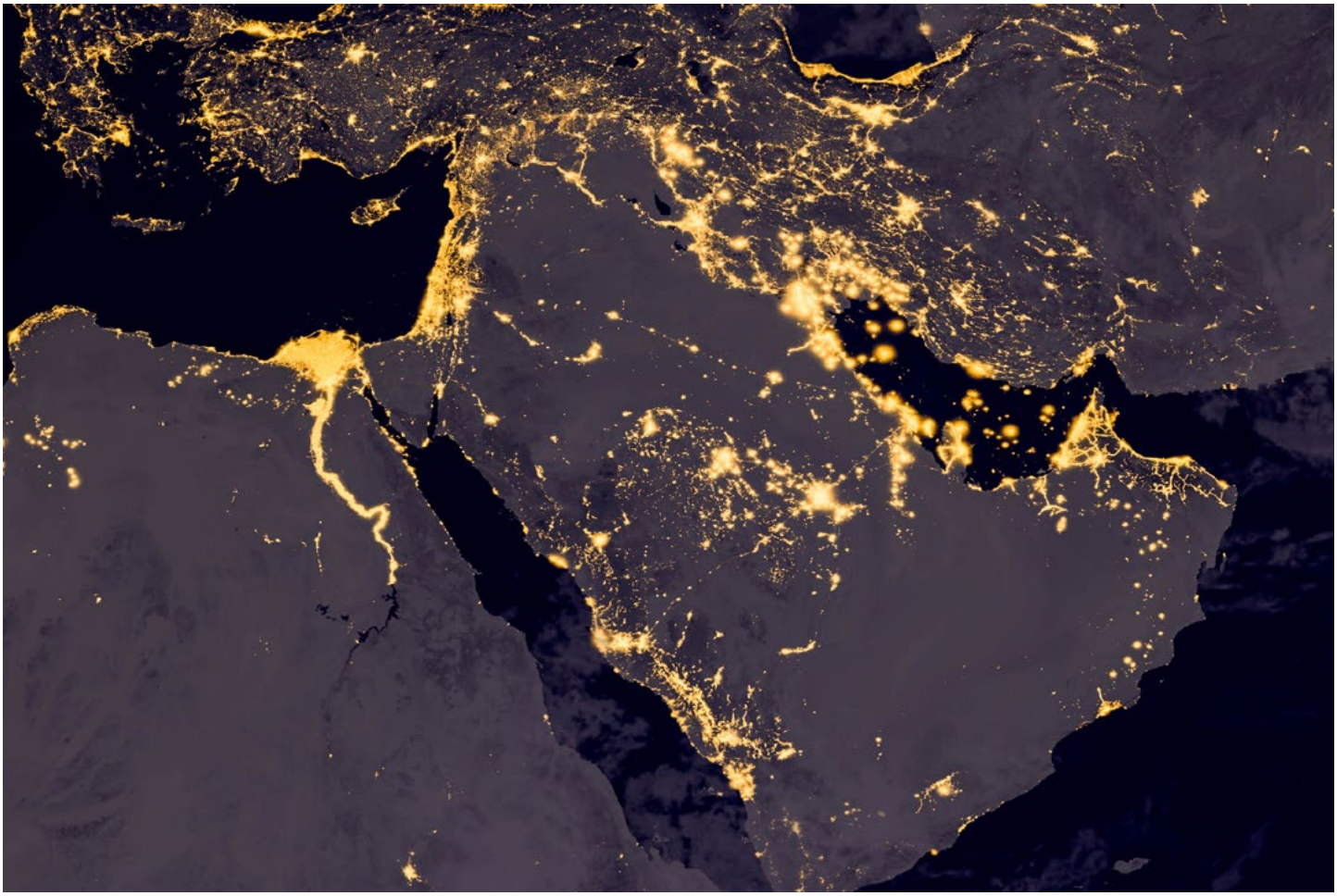
2 "Iran official details 'unsuccessful' cyber attack on port," *Iranian Labour News Agency*, May 11, 2020; "Iran says possible cyber-attack on key port averted," *Fars News*, May 19, 2020.

3 SeaNews, "Iran plans to bring its Shahid Rajaee Port to state-of-art status," *Turkey SeaNews*, September 7, 2019, https://www.seanews.com.tr/iran-plans-to-bring-its-shahid-rajaee-port-to-state-of-art-status/183880/.

4 Maxar. Worldview-1,-2 and -3. Collected on May 8, May 13, and May 16, 2020.

5 Joby Warrick and Ellen Nakashima, "Foreign intelligence officials say attempted cyberattack on Israeli water utilities linked to Iran," Washington Post, May 8, 2020, https://www.washingtonpost.com/national-security/intelligence-officials-say-attempted-cyberattack-on-israeli-water-utilities-linked-to-iran/2020/05/08/f9ab0d78-9157-11ea-9e23-6914ee410a5f_story.html; Ronen Bergman and David M. Halbfinger, "Israel Hack of Iran Port Is Latest Salvo in Exchange of Cyberattacks," New York Times, May 19, 2020, https://www.nytimes.com/2020/05/19/world/middleeast/israel-iran-cyberattacks.html; Michael Bachner, "By design, cyberattack on Iran port caused only minor damage – report," Times of Israel, May 20, 2020. https://www.timesofisrael.com/by-design-cyberattack-on-iran-port-caused-only-minor-damage-report/; Yonah Jeremy Bob, "Israeli cyber czar warns of more attacks from Iran," Jerusalem Post, May 28, 2020, https://www.jpost.com/israel-news/israeli-cyber-czar-warns-of-more-attacks-from-iran-629577.

6 "Israeli Web Users Targeted in Bungled Ransomware Campaign Leveraging Third-Party Supply Chain Compromise," FireEye, March 6, 2019; "OpJerusalem FlashInstaller Ransomware," CyberArk, March 4, 2019, https://www.cyberark.com/resources/threat-research-blog/opjerusalem-flashinstaller-ransomware; "Potential for Hacktivist Campaign Against Israeli Government and Businesses Elevated; Converging Events Lead to Increased Tensions," CrowdStrike, May 15, 2018; "International Quds Day; Historical Cases Indicate Iranian Actor Intent to Launch Cyber Attacks," CrowdStrike, June 23, 2017.



Middle East, west Asia, East Europe lights during night as it looks like from space. Elements of this image are furnished by NASA. Source: wael alreweie/Pixabay.

effects of the COVID-19 pandemic and earlier inconclusive regional conflict events—like the targeted killing of Qassem Soleimani—in which the Islamic Republic's cyber forces were unable to effectively deliver operational results.[7] Commercial intelligence services noted indications of substantial efforts toward multiple intrusions—including intention to target Israeli national telecommunications infrastructure, missile defense warning systems and Iron Dome interceptors, and maritime navigation networks.[8]

While full details of the Israeli response are not clear, the strike on the port may be considered:

- an offensive cyber effects operation with a counter-value targeting objective or
- an operational-level countering effort intended to unbalance, deny, or degrade Iranian intrusion capabilities[9]

7 Farnaz Fassihi, "Virus Lockdown Forces Iran Into Its First Virtual Quds Day," *New York Times*, May 22, 2020, https://www.nytimes.com/2020/05/22/world/middleeast/virus-virtual-quds-day.html; Kirsten Fontenrose, JD Work, Joe Slowik, James Shires, and Trey Herr, "What will follow the US strike on Major General Soleimani?" Atlantic Council, January 8, 2020, https://www.atlanticcouncil.org/commentary/press-and-members-call/atlantic-council-press-call-what-will-follow-the-us-strike-on-major-general-soleimani.; "Iranian Cyber Response to Death of IRGC Head Would Likely Use Reported TTPs and Previous Access," Recorded Future, January 7, 2020, https://www.recordedfuture.com/iranian-cyber-response.

8 "Early Warning: Social Media Posts and Identified Attack Tools Indicate Potential Pro-Palestine Cyber Attack Against Israeli Critical Infrastructure to Mark Quds Day," FireEye, May 20, 2020.

9 It should be noted that other concurrent, more tactically focused, counter-cyber operations (CCO) were also acknowledged directly by adversary actors as having degraded operations throughout May, 2020; Jerusalem Electronic Army @JEArmy0 "Urgent...The Israeli enemy is launching cyber attacks...," (translated from Arabic) Twitter, May 14, 2020, 8:07 a.m., https://twitter.com/JEArmy0/status/1260904589580218368.

It is significant that public reporting on the port attack emerged less than a day after the incident was discussed in a meeting of Israel's Ministerial Committee on National Security Affairs.[10] Whether the security cabinet intended to overtly acknowledge this operation or not, its utility as a means of communicating with Iranian leadership was reinforced by subsequent statements by senior Israeli intelligence and cyber leadership.

Deterrence lens

Deterrence works by shifting an opponent's mindset, through cost-benefit calculation, to convince them to not do something you have told them not to do. Deterrence requires several basic elements to succeed:

1. Your opponent must know what action is to be avoided;

2. Your opponent must calculate that the costs involved in taking the proscribed action credibly outweigh the benefits of inaction. The credibility of these costs rests on the opponent's conviction that you have capability to inflict those costs and a willingness to do so.

Is deterrence of cyberattacks the end state being sought through these Iranian-Israeli interactions? First consider Israel's purported action through a deterrence lens:

It should be assumed Israeli targeting of the port was based on prior operational planning—sophisticated cyber operations require significant preparation. Islamic Republic of Iran Shipping Lines (IRISL) and other regime-controlled shell companies operating in the port have been at the center of ongoing ballistic missile and nuclear proliferation activities. Involved organizations and their leadership have previously been targeted as part of economic sanctions for nearly a decade.[11] As a result, it is almost certain that earlier intelligence and reconnaissance actions could have provided insights to enable new disruptive cyber effects.

Viewed through a deterrence lens, targeting the port could be intended to produce a demonstrative effect, showing the capability to hold similar targets at risk, that signals to adversary leadership (and its population) that if Iran continues to engage in cyber operations, Israel will respond with costly retaliation. Given how difficult it can be to judge the effect and severity of a cyber-attack, some have argued their demonstration is necessary to convince target audiences of the gravity of the deterrent threat.[12] Jason Healey has termed such demonstrative offensive employment a "loud shout," distinguished from more subtle signaling mechanisms.[13] Some have argued use of an offensive capability tips the attacker's hand, allowing the defender to react, fix the revealed vulnerabilities, and design around the imposition of future costs from the same capability.[14] For this reason, it has long been considered difficult to deter through the brandishing of offensive cyber options.[15] Even where offensive cyber options are employed as a "loud shout," adversaries may not receive the message that planners might have intended, believing their knowledge of the attack prepares them to neutralize its use in the future.[16]

It is possible that action against the Bandar Abbas port facility presented a unique opportunity for demonstrative attack without disclosing an exquisite (highly effective and hard to reproduce) capability unknown to the adversary. At least one prior campaign was reportedly conducted between spring 2010 and fall 2012 to degrade proliferation-related targets, likely including Iranian shipping operations.[17] A destructive malware variant was also observed in connection with attacks on multiple

10 Judah Ari Gross, "Cyberattack on port suggests Israeli tit-for-tat strategy, shows Iran vulnerable," *Times of Israel*, May 19, 2020, https://www.timesofisrael.com/cyberattack-on-port-suggests-israeli-tit-for-tat-strategy-shows-iran-vulnerable/.

11 US Department of the Treasury, "Treasury Sanctions Major Iranian Commercial Entities," June 23, 2011, https://www.treasury.gov/press-center/press-releases/Pages/tg1217.aspx; US Department of the Treasury, "US Government Fully Re-Imposes Sanctions on the Iranian Regime as Part of Unprecedented US Economic Pressure Campaign," November 5, 2018, https://home.treasury.gov/news/press-releases/sm541.

12 Martin C. Libicki, *Cyber Deterrence and Cyber War*, RAND, 2009; (Conventional deterrent threats have suffered from the same capability credibility gap under certain conditions as well), in Richard J. Harknett, "The Logic of Conventional Deterrence and the End of the Cold War," *Security Studies* 4.1 (Autumn 1994), 86-114.

13 Jason Healey, "The Cartwright Conjecture: The Deterrent Value and Escalatory Risk of Fearsome Cyber Capabilities," in *The Strategic Dimensions of Offensive Cyber Operations*, ed. Herbert Lin, Amy Zegart, (Brookings Institution Press), 2018.

14 Richard J. Harknett, John Callaghan, and Rudi Kaufmann, "Leaving Deterrence Behind: Warfighting and National Cybersecurity," *Journal of Homeland Security and Emergency Management*, Vol. 7.1 (Spring 2010), 1-24.

15 Martin C. Libicki, *Brandishing Cyberattack Capabilities*, RAND, 2013.

16 Evan Braden Montgomery, "Signals of strength: Capability demonstrations and perceptions of military power," *Journal of Strategic Studies*, 43.2, 2020, 309-330.

17 "W32.Narilam – Business Database Sabotage," Symantec, November 22, 2012, https://community.broadcom.com/symantecenterprise/communities/community-home/librarydocuments/viewdocument?DocumentKey=67059af3-3941-4f3f-bd8c-f788b984501a&CommunityKey=1ecf5f55-9545-44d6-b0f4-4e4a7f5f5e68&tab=librarydocuments ; "Narilam Trojan Targets Iranian Financial Software," McAfee, November 29, 2012, https://www.mcafee.com/blogs/other-blogs/mcafee-labs/narilam-trojan-targets-iranian-financial-software/; "Narilam trojan : A New Destructive Malware," RSA, December 10, 2012, https://community.rsa.com/thread/123243.

oil terminal facilities during the same 2010-2012 period. While eventually detected by Iranian defenders and attributed by foreign researchers to then ongoing Duqu and Flame campaigns allegedly conducted by Israel against Iran, the operation was never acknowledged and substantial unknowns about the incidents still persist.[18] Despite these unknowns, the precedent of earlier actions meant that while specific instances of given vulnerabilities that offered continuing options for disruption of the port networks might be highlighted in the new operation, the class of offensive capabilities employed were already understood by the adversary and therefore did not risk other more novel options.

Such action would further be consistent with the Israeli services' thinking regarding proportionate response options as articulated around kinetic actions. In these cases, strikes intended to have deterrent value as part of efforts to sustain regional stability are delivered against targets previously identified through intelligence, and serve specific strategic objectives in addition to their signaling value.[19] This rationale underlies arguments that recent cyber operations were intended as retaliatory actions—demonstrating that any attacks on Israeli networks would be met by proportionate actions against the aggressor.[20]

However, it is not clear that an Israeli cyber operation against the port was necessary for deterrence. Does Iran really doubt that causing Israeli deaths would lead to Israeli retaliatory action? If so (and thus precipitated a cyber operation), disrupting port services is quite an indirect way to draw such a red line and it is certainly not proportional to the loss of life that could have followed a successful Iranian attack on the water treatment facility. Since it was not proportional, in fact taking such action might create the opposite outcome--deterrence credibility would be undermined in the eyes of the Iranians who would see the Israelis responding mildly to their action. The salient deterrent point is that past Israeli kinetic action has likely established the red line against killing Israelis and has established credibility around both the Israeli capability and will to inflict costs. It is unclear if Iranian calculations view kinetic exchange or conventional war as cost prohibitive. If they do not then deterrence has failed, and cyber operations at this level are unlikely to reestablish it.

Cyber persistence lens

An alternative explanation is that Israel and Iran understand that cyberspace itself has an interconnected structure that creates a distinct strategic environment. Rather than security ultimately resting on the absence of some proscribed action (deterrent threat), each recognizes that security, in a highly fluid environment of constant contact, flows from being able to sustain initiative in anticipating and exploiting vulnerabilities inherent in networked computing (and the systems and interfaces that constitute the network). Thus, the non-acknowledged public glimpse into cyber operations between the two states reveals a competition through a continuous set of cyber operations across multiple campaigns that amounts to a grappling over who can more effectively anticipate the other. When effective defensively, vulnerabilities are not exploited as the actual conditions of each other's insecurity are set and reset. Security requires persistence in cyber operations and perhaps Israel and Iran are learning this through a set of managed cyber interactions.

The Iranian attributed intrusion against Israeli water sector targets was not a "bolt out of the blue" attack, but rather part of recurring hostile competition over security. The incident is linked to ongoing campaigns and related capabilities development since at least late 2017. Initial access likely developed from Iranian and Iranian proxy efforts to target electric power distribution networks in Israel which have been ongoing since at least early 2016. Earlier phases of this cyber campaign were detected and publicly disclosed as ELECTRIC POWDER, leading the adversary to shift to new intrusions using modified tooling and new infrastructure. Fresh intrusions were observed in spring 2019, including apparent compromise of a technology start-up firm providing automation device management solutions for Israeli utilities.[21] While these intrusions do not appear to have resulted in the same potential for disruption in the energy sector, they may have provided insight supporting later action against water sector targets in Israel.

Iranian targeting of the water sector was likely further informed by planners' awareness of an entirely separate incident in Ukraine. Here, a Russian origin intrusion was detected by

18 Ben Buchanan, *The Hacker and the State*, (Harvard University Press, 2020), 112-115; Thomas Erdbrink, "Facing Cyberattack, Iranian Officials Disconnect Some Oil Terminals From Internet," *New York Times*, April 23, 2012, https://www.nytimes.com/2012/04/24/world/middleeast/iranian-oil-sites-go-offline-amid-cyberattack.html.

19 Ronen Bergman, *Rise and Kill First: The Secret History of Israel's Targeted Assassinations,* (New York: Random House, 2018).

20 Thomas Warrick, "If the US launches cyberattacks on Iran, retaliation could be a surprise," Fifth Domain, January 30, 2020, https://www.fifthdomain.com/thought-leadership/2020/01/30/if-the-us-launches-cyberattacks-on-iran-retaliation-could-be-a-surprise/.

21 ClearSky, "Operation Electric Powder - who is targeting Israel Electric Company?", March 14, 2017, https://www.clearskysec.com/iec/; "Threat Activity Report: Israeli Energy Sector Targeted Using ANTFARM, SNAKEBASE Disruptor, and Other Malware," FireEye, May 29, 2019.

Ukrainian security services after compromising the network at a water treatment facility near Dnipropetrovsk - prompting a public warning widely discussed within the information security community.[22] This incident was almost certainly tracked by an Iranian offensive cyber acquisition program, ongoing since at least 2014, that seeks to identify new capabilities and mimic them through reverse engineering and/or parallel re-development.[23] This parallel development program is conceptually similar to Russian and other Western programs, and likely later evolved based on public disclosures around capture and replay acquisition techniques.[24] Subsequently, intrusions against water sector targets in the Gulf region, attributed to an Iranian-linked activity group—commonly known as APT34, HELIX KITTEN, COBALT GYPSY, or OILRIG—were observed in November 2018.[25] Critically, APT34 capabilities would be degraded in spring and early summer 2019 following a series of third-party leaks from a hacktivist group that exposed the activity group's tools and active intrusions.[26] While APT34 and other associated activity groups responded by retooling and rebuilding supporting infrastructure, the higher profile of the operations and loss of deniability (however implausible), likely led to emphasis on other capabilities for planned action against the Israeli targets.

The alternative capabilities leveraged by successor campaigns to ELECTRIC POWDER were also less technically mature, having originally been aimed to imitate, and thus be confused with, a previously identified Palestinian origin threat activity group known as Molerats or EXTREME JACKAL.[27] EXTREME JACKAL has reportedly operated from the Gaza area since at least 2012 and was well known to Israeli intelligence.[28] EXTREME JACKAL hackers had previously been targeted in Israeli response actions that included kinetic airstrikes in 2019 against the group's HAMAS-linked facilities.[29] Iranian operators are known to have previously leveraged hacktivist personas as a means of muddling attribution since at least 2009, and pursuing operations under a similar front would be consistent with this history. While commercial cyber intelligence services have not definitively confirmed the link, threats issued via social media from the "Jerusalem Electronic Army" (JEA) in April 2020, as response to Israeli computer emergency response team (CERT) warnings regarding water sector operations, may have been intended to continue this deception.[30] These threats included a claim to have compromised energy sector networks consistent with prior ELECTRIC POWDER targeting.[31]

22 "SBU thwarts cyber attack from Russia against chlorine station in Dnipropetrovsk region," Interfax Ukraine, July 11, 2018, https://en.interfax.com.ua/news/general/517337.html.

23 Interview with an Iranian defector previously involved in offensive cyber operations by author JD Work, November 2014.

24 Dominik Reichel and Esmid Idrizovic, "AcidBox: Rare Malware Repurposing Turla Group Exploit Targeted Russian Organizations," Palo Alto Networks, June 17, 2020; "Russian-Speaking Actor 'Digital Revolution' Leaked Documents on an Alleged FSB IoT Botnet Called 'Fronton,'" FireEye, April 6, 2020; Patrick Wardle, "Repurposed Malware: A Dark Side of Recycling," RSA Conference, San Francisco, February 24-28, 2020; "Advanced Red Teaming Techniques - Malware Authoring and Repurposing," FireEye, FLARECON, August 3-6, 2019. ; Joshua Pitts, "Repurposing OnionDuke: A Single Case Study Around Reusing Nation State Malware," Black Hat USA, Las Vegas, August 6, 2015; "Hacking Team's Galileo RCS - Repurposing espionage software," 4Armed, July 15, 2015, https://www.4armed.com/blog/hacking-teams-galileo-rcs-repurposing-espionage-software/ ; "Russian Center for Computer Incident Response," iSIGHT Partners, June, 2011.

25 Remarks under Chatham House Rule at Cyber Conflict Studies Association, "Bridging the Gap: Workshop on Cyber Conflict," Reston, VA, November 29-30, 2018.

26 Andy Greenberg, "A Mystery Agent Is Doxing Iran's Hackers and Dumping Their Code," *Wired*, April 18, 2019, https://www.wired.com/story/iran-hackers-oilrig-read-my-lips/.

27 "SPLITAMP Malware Identified Targeting Israeli Entities," FireEye, February 6, 2019.

28 "Molerats Delivers Spark Backdoor to Government and Telecommunications Organizations," Palo Alto Networks, March 3, 2020, https://unit42.paloaltonetworks.com/molerats-delivers-spark-backdoor/; "New Cyber Espionage Campaigns Targeting Palestinians - Part 1: The Spark Campaign," Cyberreason, February 13, 2020, https://www.cybereason.com/blog/new-cyber-espionage-campaigns-targeting-palestinians-part-one; "Operation DustySky," ClearSky, January, 2016, https://www.clearskysec.com/wp-content/uploads/2016/01/Operation%20DustySky_TLP_WHITE.pdf; "Molerats, Here for Spring!" FireEye, June 2, 2014, https://www.fireeye.com/blog/threat-research/2014/06/molerats-here-for-spring.html; "Operation Molerats: Middle East Cyber Attacks Using Poison Ivy," FireEye, August 23, 2013, https://www.fireeye.com/blog/threat-research/2013/08/operation-molerats-middle-east-cyber-attacks-using-poison-ivy.html.

29 Robert Chesney, "Crossing a Cyber Rubicon? Overreactions to the IDF's Strike on the Hamas Cyber Facility," Lawfare, May 6, 2019, https://www.lawfareblog.com/crossing-cyber-rubicon-overreactions-idfs-strike-hamas-cyber-facility; Lily Hay Newman, "What Israel's Strike on Hamas Hackers Means For Cyberwar,"*Wired*, May 6, 2019, https://www.wired.com/story/israel-hamas-cyberattack-air-strike-cyberwar/.

30 "Preliminary Analysis – OT Systems in Israeli Water & Wastewater Sector Targeted Possibly by Jerusalem Electronic Army," FireEye, May 7, 2020.

31 Jerusalem Electronic Army. "The penetration of the solar energy system…" (Translation from Arabic.) Twitter. April 4, 2020. https://twitter.com/JEArmy0/status/1247152094953402368

The JEA-front persona would also claim to have successfully compromised military surveillance systems and other targets associated with Israeli "settlements" in May and June 2020, providing imagery as purported proof.[32] A second affiliated hacktivist group persona would subsequently claim further actions against industrial control systems targets in specific kibbutz communities in June 2020—implicitly crediting these intrusions to the HAMAS military wing, Izz Al-Din Al-Qassam Brigades, in a likely attempt to support the theme of widespread resistance.[33] Additional, as yet technically unattributed cyber attacks would reportedly compromise Israeli agricultural water systems in mid-July 2020.[34] These attacks would be claimed by the JEA attribution front as part of what it suggests are ongoing operations.[35] Concurrently, the JEA would also claim to have suffered degradation of its infrastructure by Israeli counter-cyber operations.[36] None of these cyber operations should be fully understood outside the context of ongoing campaigns to anticipate each other's exploitation of vulnerabilities; they are all part of continuing competition between Iran and Israel.

So, from a cyber persistence perspective what should analysts make of the specific purported Israeli action against Shahid Rajaei port at Bandar Abbas? Here what appears tactically to be an offensive action may from an operational and campaign level be better understood as unbalancing an opponent, opening a different vector for Iran to defend, thus shifting the initiative back to Israel as Iran must be on guard for exploitation of vulnerabilities it had not effectively anticipated. Rather than sending signals in the hope of deterrence, Israel is actively resetting relative security and insecurity in and through cyberspace.

Implications and outlook: Double vision, through both lenses

The empirical record, despite its opaque nature, suggests that Iran and Israel are engaged in cyber operations of a continuous nature. This could be resulting from the failure of both sides to set sufficiently credible deterrent threats and, despite this failure, both sides are struggling to find a specific deterrent line each can hold. If so, this is a dangerous period as the nature of cyberspace suggests this attack-retaliate model of deterrence will likely lead to ever-increasing exchanges in which each side expects its escalation in intensity to finally adjust the thinking of the other side. Without mutual loss clearly understood by each party, such continued escalation may lead to a cyber operation that spurs a cross-domain kinetic exchange or, worse, war.

The empirical record might be understood differently. Both states might understand that they need to continuously grapple in cyberspace to anticipate what the other side might seek to exploit. Rather than trying to lock in inaction (cease and desist), the objective is to sustain relative security through initiative that allows one to establish conditions for security for themselves and insecurity for the other side. Without the roadmap of experience, these interactions could also lead to error, and a level of conflict that neither side is actually seeking.

However, if both sides desire to manage the challenge of cyber persistence, a more hopeful interpretation is possible. Then, these operations would align with the strategic realities of cyberspace and leave open the possibility for learning through action. Israel and Iran may, through their continuous cyber operations, become adept at understanding operations that have value short of war (produce relative security in reducing cyber exploitation) as opposed to those risking dangerous cross-domain action (if understood as conventional war).

Further distorted vision

The above analysis rests on the assumption that the observed behavior between Iran and Israel is driven through strategic calculation—that the two states are assessing their national interests, the strategic environment of cyberspace, and aligning their operations to achieve a better cyber strategic outcome, along with advancing their interests within their broader regional rivalry statecraft. Two alternative possibilities must also be acknowledged which further distorts the explanation of what we are seeing.

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32 Jerusalem Electronic Army, "Penetration of an Israeli military surveillance and monitoring system in Ramat Gan..." (Translation from Arabic), Facebook, July 15, 2020; Jerusalem Electronic Army. "The electronic army of Jerusalem penetrates a military surveillance system." (Translation from Arabic). Twitter. 11 June 2020. https://twitter.com/JEArmy0/status/1271049316631707649 ; Jerusalem Electronic Army @JEArmy0, "Electronic attack which comes in response to the decision to annex West Bank settlements," (Translation from Arabic), Twitter, May 30, 2020, 9:42a.m., https://twitter.com/JEArmy0/status/1266726690060984326.

33 "Actor 'Anonymous Islamic Army' Claimed to Compromise an Israeli Automation Engineering Company," FireEye, June 18, 2020.

34 Toi Staff,"Cyber attacks again hit Israel's water system, shutting agricultural pumps," Times of Israel, July 17, 2020, https://www.timesofisrael.com/cyber-attacks-again-hit-israels-water-system-shutting-agricultural-pumps/.

35 Jerusalem Electronic Army, "Al-Quds Electronic Army launches attacks for the fourth consecutive day, its attacks target the economic, security and military system, and the Israeli enemy incurred heavy material and information losses," (Translation from Arabic), Twitter, July 9, 2020. https://twitter.com/JEArmy0/status/1281194494566825985 ; Jerusalem Electronic Army, "...hack for the second time the Israeli water system...,"(Translation from Arabic), Facebook, July 15, 2020; Jerusalem Electronic Army, "Last week, the joint units carried out more sensitive cyber attacks..." (Translation from Arabic), Facebook, July 15, 2020.

36 Jerusalem Electronic Army, "...the cowardly enemy inversely attacked ... servers operating in the resistance..." Facebook, July 15, 2020.

First, it is possible that the Iranian incursion into water treatment facilities is a result not of deterrence or cyber initiative, but bureaucratic politics. Iranian reliance on the ELECTRIC POWDER activity group at the forefront of the Qods Day thrust may have emerged as a result of internal service rivalries. Following setbacks to other Iranian Revolutionary Guards Corps (IRGC) and Ministry of Intelligence and Security (MOIS) capabilities, planners possibly sought to employ what they believed to be undetected capabilities in a "spectacular" event. This event was likely timed to coincide with other propaganda activities—including what may have been intended as new ballistic missile testing at the culmination of ongoing naval exercises—a highly desirable comparative milestone for a previously under-regarded offensive program. The alleged "joint" nature of the Jerusalem Electronic Army front—purported to be cooperating with the Syrian Electronic Army, and multiple other entities including acknowledged Iranian nationalist hackers—likely also reinforces these dynamics. The IRGC has reportedly invested heavily in training Palestinian, Syrian, and Lebanese hackers for many years.[37] This operation would likely have demonstrated return on these investments. As it turned out however, both naval and cyber engagements resulted in disaster for the Islamic Republic.[38] So it is possible that domestic pressures reflected through bureaucratic competition to please central leaders might have led to a riskier, more adventurist, cyber operation.

Alternatively, the alleged Israeli cyber strike on the port facility might have had little to do with cyber deterrence or persistence, but rather been part of a larger effort to undermine Iran's nuclear proliferation. It is possible that Israel is using cyber means in a counter-proliferation campaign to slow, disrupt, and potentially destroy Iranian nuclear capacity. The broad nature of disruption caused by reported action against the Bandar Abbas network is not as clearly consistent with this objective. However, subsequent additional kinetic disruption was reported at multiple facilities in Iran in late June and early July 2020, including explosions at the Shahid Bakeri Industrial Group ballistic missile manufacturing facility, and most critically the Natanz Pilot Fuel Enrichment Facility centrifuge assembly hall. There are few details on these events at present and the Iranian government has been less than forthcoming, no doubt in part to conceal both the existence of the illicit programs at these locations as well as the degree of damage inflicted upon the regime's aspirations. However, unconfirmed allegations—including reported statements by Iranian government officials—have surfaced suggesting offensive cyber operations may have played a role in these incidents.[39] Other regional intelligence sources point toward more classic sabotage scenarios, including covert emplacement of explosives at the target facility through insider access. Israeli officials have avoided addressing questions of involvement.[40] Yet commercial overhead imagery has identified specific features of the explosion that may

37 JD Work, "Echoes of Ababil: Re-examining formative history of cyber conflict and its implications for future engagement," Society of Military History Annual Conference, Cincinnati, OH, May 9-12, 2019.

38 Megan Eckstein, "Iranian Friendly Fire Incident Kills 19, After Frigate Fires Missile At Support Ship," *US Naval Institute*, May 11, 2020, https://news.usni.org/2020/05/11/iranian-friendly-fire-incident-kills-19-after-frigate-fires-missile-at-support-ship.

39 "New details about the Iranian Natanz explosion," *Al Jarida*, July 7, 2020; Fabian Hinz, Aaron Stein, "Mysterious Explosions in Iran," Arms Control Wonk/Foreign Policy Research Institute Middle East Brief podcast, July 6, 2020, https://www.armscontrolwonk.com/archive/1209708/mysterious-explosions-in-iran/.; Seth J. Frantzman, "Arabic media: Israeli cyberattack struck Natanz nuclear facility," *Jerusalem Post*, July 3, 2020, https://www.jpost.com/middle-east/iran-news/arabic-media-israeli-cyberattack-struck-natanz-nuclear-facility-633775; "Iran vows to take revenge after a cyber attack on a nuclear facility," *Al Jarida*, July 3, 2020, [can't find link]; "Second explosion at sensitive nuclear facility in a week," *Al Jarida*, July 3, 2020, [can't find link], ; Fabian Hinz, "What Iranian Authorities Hid About The Big Explosion In East Tehran," Radio Farda, June 27, 2020, https://en.radiofarda.com/a/what-iranian-authorities-hid-about-the-big-explosion-in-east-tehran/30693889.html.

40 Lahav Harkov, "Ashkenazi on Iran explosions: Our actions are better left unsaid," *Jerusalem Post*, July 5, 2020, https://www.jpost.com/israel-news/ashkenazi-on-natanz-explosion-our-actions-in-iran-better-left-unsaid-633923; Joby Warrick, Souad Mekhennet, and Steve Hendrix, "Signs increasingly point to sabotage in fiery explosion at Iranian nuclear complex," *Washington Post*, July 6, 2020, https://www.washingtonpost.com/national-security/signs-increasingly-point-to-sabotage-in-fiery-explosion-at-iranian-nuclear-complex/2020/07/06/d1035e84-bfce-11ea-b178-bb7b05b94af1_story.html.

indicate an apparent locus of damage traced along a specific gas delivery pipeline leading into the facility—in some scenarios potentially consistent with cyber-enabled effects, although analysis remains deeply inconclusive. [41]

Additional incidents, including an industrial chlorine leak at the Karun petrochemical plant in Mahshahr, have also raised tensions; without any evidence to yet link these events.[42] Despite this, industrial failures in key Iranian infrastructure remain under intense scrutiny where they appear potentially consistent with previously disclosed contingency planning for large-scale counter-proliferation focused cyber operations, allegedly abandoned in favour of the negotiations process that resulted in the Joint Comprehensive Plan of Action (JCPOA). The prospect of such a campaign continues to loom large in Iranian official thinking.[43] With the failure of JCPOA, cyber options to deny and degrade Iranian progress toward an operational nuclear warhead and associated delivery capability presumably remain on the table—alongside other measures short of full-scale conventional military strikes.[44] However, it is far from clear that any specific counter-proliferation focused covert action that may, or may not, be ongoing is linked to continuing contests over control of networks for more conventional objectives. It is difficult to isolate threads of strategic thrust within opaque exchanges between antagonists acting in and through cyberspace. Inappropriately conflating separate campaigns including those pursued by differing actors, using different mechanisms of action and effect, and toward different national interests—remains a substantial challenge to accurately evaluating key components of state interactions in cyberspace. While it can be assumed cyber operations sit within the context of broader statecraft, we may be missing the full picture by assuming they are simply additional means to that statecraft, rather than seeing them as evidence of a contest over a new strategic domain itself with its own dynamics and ends in play—cyber statecraft in action.

Clearer vision

For those focused on cyber operations and the potential for strategic cyber-enabled campaigns, what can be generalized about the cyber interactions between Israel and Iran requires more scrutiny, but some basic analytical principles seem important to adopt:

1. Observers should not assume that the actions seen are necessarily reflections of accurate strategic calculation. It is possible that both states think they can deter despite all evidence to the contrary and thus the prospect exists that continuous failure to deter will lead to greater danger;

2. Observers should not assume that the actions seen are working even if aligned to the operational environment. It is possible that both sides are engaged in trying to manage an operational environment that rewards persistence, but given the lack of sophisticated experience this may lead not to relative security but the greater danger of relative insecurity;

3. Observers should not assume that the narratives that build up around specific cyber operations (and sometimes allowed intentionally to propagate by the actors themselves) are necessarily reflective of an episodic operation. It is possible that the operation itself is not what it seems to be. It is possible that it is a false narrative or, alternatively, not an isolated act at all but rather a part of a much larger campaign of which we are catching only a fleeting glimpse.

The unsatisfactory conclusion, thus, is that cyber security studies, analysts, and policymakers alike must work hard to perfect the lens through which greater clarity concerning cyber operations, campaigns, competition, and conflict will be obtained. This goal, at times, (such as in this analysis) may be forwarded by raising more questions than delivering answers, but such is the nature of the challenge faced in understanding where cyberspace fits in the relations of states.

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41 David Albright, Sarah Burkhard, and Frank Pabian, *Update on Assessing the Detonation at the Natanz Iran Centrifuge Assembly Center: New High Resolution Satellite Imagery Refines Details on the Explosion and Fire*, Institute for Science and International Security, July 9, 2020 ; David Albright, Sarah Burkhard, and Frank Pabian, *Damage to the Iran Centrifuge Assembly Center (ICAC) at Natanz Is Far More Severe and Extensive Than Previously Reported*, Institute for Science and International Security, July 8, 2020 ; David Albright, Sarah Burkhard, and Frank Pabian, *Mysterious Fire and Explosion in the New Natanz Advanced Centrifuge Assembly Facility*, Institute for Science and International Security, July 3, 2020.

42 "Seventy injured at Iran petrochemical plant accident," *Iran Students News Agency*, July 4, 2020.

43 "Official: US resorting to cyber-attacks on Iran," Mehr News, May 31, 2018 ; "Senior Official Warns of US Plot to Disable Iran's Power Grid," *Fars News Agency*, April 10, 2017; "Civil Defense Official Warns of New US Cyber Attack against Iran," *Fars News Agency*, December 12, 2016, https://en.farsnews.ir/newstext.aspx?nn=13950922001235.; "Iran Confirms Finding US Electronic Implants in Infrastructures," *Fars News Agency*, October 24, 2016, https://english.farsnews.ir/newstext.aspx?nn=13950803001056 ; David E. Sanger and Mark Mazzetti, "US Had Cyberattack Plan if Iran Nuclear Dispute Led to Conflict," *New York Times*, February 17, 2016· https://www.nytimes.com/2016/02/17/world/middleeast/us-had-cyberattack-planned-if-iran-nuclear-negotiations-failed.html.

44 David E. Sanger, Eric Schmitt, and Ronen Bergman, "Long-Planned and Bigger Than Thought: Strike on Iran's Nuclear Program," *New York Times*, July 10, 2020, https://www.nytimes.com/2020/07/10/world/middleeast/iran-nuclear-trump.html.

Understanding these three analytical points moving forward is important as it should be assumed that cyber interactions between Iran and Israel will continue within the larger context of their regional hostility. How policymakers, planners, and operators understand specific actions and intended objectives therefore becomes increasingly vital as each side continues to grapple with the new dimensions of cyber operations as mechanisms of competition and conflict. Longstanding conceptual frameworks have offered great utility over the decades in helping to provide insight into these behaviors, but where unique features of the new domain may change the underlying determinants of key interactions it becomes critical to pursue new lenses that may offer greater clarity. Such clarity is much needed where the potential errors of observation, interpretation, and action may risk wider crisis. Therefore, one would hope that, minimally, allies of Israel are creating opportunities to learn from these operations to enhance thinking in both directions.

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