Chinese Emerging Technological Convergence: Enabling Intelligent Warfare with Artificial Intelligence

by Chief Warrant Officer 5 Jason A. Kinsey

China's Emerging Technology Ambition

During his confirmation hearing in 2021, Secretary of Defense Lloyd Austin stated, "China is ascending. Russia is also a threat…but China is the pacing threat."[1] Aside from focusing on countering United States interests in the region, China has identified strategic goals to complete the modernization of national defense and the military by 2035, as outlined in its most recent defense strategy, *China's National Defense in the New Era*. The convergence of technologies like artificial intelligence, big data, the Internet of Things, and unmanned weaponry serves as an evolution for the People's Liberation Army (PLA) modernization effort to *intelligentization*, or intelligent warfare.[2]

Intelligentization

Intelligentization is the uniquely Chinese concept of applying [artificial intelligence's] AI's machine speed and processing power to military planning, operational command, and decision support….The PLA's agenda for intelligentization may prove quite expansive, extending across all concepts in which AI might have military relevance in enabling and enhancing war-fighting capabilities, from logistics to early warning and intelligence, military wargaming, and command decision-making.[3]

U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-92, *The Operational Environment and the Changing Character of Warfare*, linked China's ascension to the continued advancement of emerging and disruptive technologies in the next 10 to 15 years.[4] The ability to conduct intelligent warfare and achieve a decisive strategic and tactical advantage in all-domain operations will require the technological convergence of artificial intelligence and next-generation communications. These technology enablers will foster a robust military Internet of Things to facilitate the data management required for autonomous decision making and intelligent weaponry. China's ability to achieve technological superiority by 2035 or sooner will give the PLA the ability to undermine United States deterrence efforts regionally and permit China to limit United States influence globally.

In a 2020 Department of Defense report to Congress, PLA strategists believe that "victory in future warfare…will depend upon which side can more quickly and effectively observe, orient, decide, and act [OODA] in an increasingly dynamic operating environment."[5] This belief will fuel the PLA's artificial intelligence efforts to develop sophisticated machine learning and deep learning algorithms for deployment in autonomous command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems, enhancing awareness in an increasingly complex operating environment. Additionally, these algorithms will simultaneously endow PLA platforms to degrade and deny an adversary's capabilities, complicating their OODA loop and increasing destructive course-of-action employment.

The Difference between Deep Learning and Machine Learning

Deep learning is a subset of machine learning. Machine learning is about computers being able to think and act with less human intervention; deep learning is about computers learning to think using structures modeled on the human brain. Machine learning requires less computing power; deep learning typically needs less ongoing human intervention. Deep learning can analyze images, videos, and unstructured data in ways machine learning can't easily do.

While basic machine learning models do become progressively better at whatever their function is, they still need some guidance. If an artificial intelligence algorithm returns an inaccurate prediction, then an engineer has to step in and make adjustments. With a deep learning model, an algorithm can determine on its own if a prediction is accurate or not through its own neural network.[6]

Following the victory of Google's AlphaGo, a deep neural network consisting of supervised and reinforcement learning algorithms, at the Go human world championship in 2016, PLA strategists recognized the potential for intelligentization to surpass human command decision making.[7] The China State Council followed up in 2017 with the release of an aspirational document titled *New Generation Artificial Intelligence Development Plan*, establishing the framework to become the global leader in artificial intelligence by 2030.[8] The plan highlighted many of China's efforts to advance artificial intelligence technologies, including voice and facial recognition, autonomous learning, swarm intelligence, robotics, and unmanned systems.[9] While identifying components necessary for intelligent warfare, the document also promoted

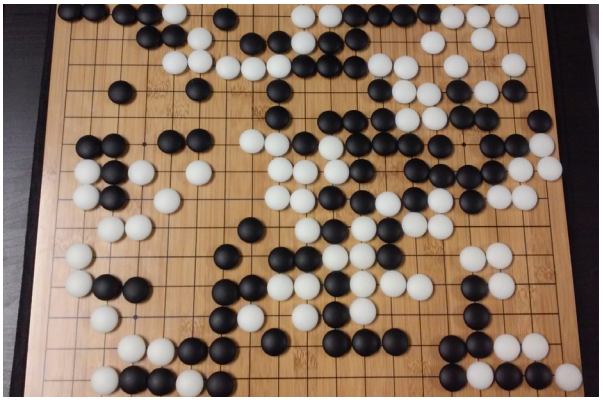
the importance of military-civil fusion to stimulate artificial intelligence innovation in the name of national security and an intelligentized PLA.[10] Chinese president Xi Jinping later nationalized military-civil fusion efforts, anticipating that top-down policies and state-owned enterprises will afford China an innovation advantage in the emerging technology sector and enable intelligent warfare.[11]

The Artificial Intelligence Lifeline

Just as information is crucial for multi-echelon decision making, the successful employment of artificial intelligence for intelligent warfare requires the accumulation and integration of information across all operational domains, marking the need for effective data management analytics. In recent years, strategists and PLA officers have written countless articles in official Chinese journals and publications, spotlighting the importance of data management in support of intelligent warfare, likening data to combat power and the blood of intelligent warfare.[13] PLA writings go on to describe the necessity for data management in support of command decision making, calling for data mining and deep learning algorithms to autonomously learn from the multifaceted data streams ingested from sensors and systems across the multidomain battlespace.[14]

AlphaGo

The game of Go, which originated in China more than 2,500 years ago, is an abstract war simulation. Players start with a completely blank board and place black and white stones, one at a time, to surround territory. Once placed, stones do not move, and they're removed only if they're "killed"—that is, surrounded completely by the opponent's stones…Because there are so many directions any given game can move in, Go is a notoriously difficult game for computers to play. In 2016, the Google-owned artificial intelligence company DeepMind shocked the world by defeating South Korean Go champion Lee Se-dol four matches to one with its AlphaGo AI system.[12]



With state-sponsored initiatives and strategies like military-civil fusion, the PLA is actively exploring ways to integrate and disseminate the blood of intelligent warfare for improved situational awareness across echelons and supporting targeting for precision strike capabilities.[15] Army Futures Command has a similar effort, Project Convergence, to use artificial intelligence and autonomous systems to link multidomain sensors and shooters to neutralize enemy ISR and long-range fires.[16] For these efforts to be successful, data-hungry artificial intelligence algorithms require a sophisticated communications infrastructure to foster collaboration between a sensor-rich environment of manned and unmanned C4ISR platforms providing critical information to accommodate decision making and targeting.

5G: Emerging Technology Enabled by Next-Generation Communications

Ongoing deployment of the fifth-generation (5G) infrastructure provides the foundation for enabling the data-rich military Internet of Things. 5G aims to deliver higher speeds (up to 100 times faster than fourth generation) and lower latency (within 1 millisecond) communications and enhance massive machine-to-machine communications.[17] Aside from speed, radio frequency (RF) agility or RF spectrum management sets 5G apart from legacy generations, allowing data optimization for reliable, instantaneous, and abundant device and sensor connectivity. To accomplish this, 5G will rely on several innovations like millimeter-wave transmissions, small cell base stations, massive multiple-input and multiple-output antennas, and beamforming.[18]

Millimeter wave, a novel feature of 5G, allows for expansion of the RF spectrum for wireless devices to the 24 to 39 gigahertz (GHz) range, creating RF agility.[19] Essentially, 5G will operate in two groups: below 6 GHz, which existing wireless mobile communications use, and millimeter wave, depending on the network conditions, requirements, and device capabilities.[20] Artificial intelligence innovations supporting big data analytics, cloud, and edge computing, millions of small cell base station deployments, massive multiple-input and multiple-output antennas, and beamforming enhancements provide 5G dual-use opportunities. With military-civil fusion, Chinese engineers can develop 5G-capable intelligentized military platforms interoperable with legacy communications infrastructure yet able to adjust to a complex operating environment.

The 2020 United States–China Economic and Security Review Commission's Annual Report to Congress highlighted China's ambitious 5G plan. The commission noted China relies on a "cluster of revolutionary new technologies," including artificial intelligence, robotics, interconnected sensors, and 5G, to surpass the United States economically and militarily.[21] Backing that initiative, the People's Republic of China unveiled a state-sponsored "new infrastructure" investment strategy totaling $1.4 trillion on 5G architecture, artificial intelligence initiatives, and other telecommunication efforts to benefit defense and commercial industries.[22] Designed to fortify China's goal of reducing foreign dependence on technology and gaining a first-mover advantage in 5G, the funding enables innovations in autonomous unmanned systems and other dual-use technologies.[23] With more than 200 million 5G users, 144 million 5G devices, and 700,000 base stations deployed in China, there are projections for another 600,000

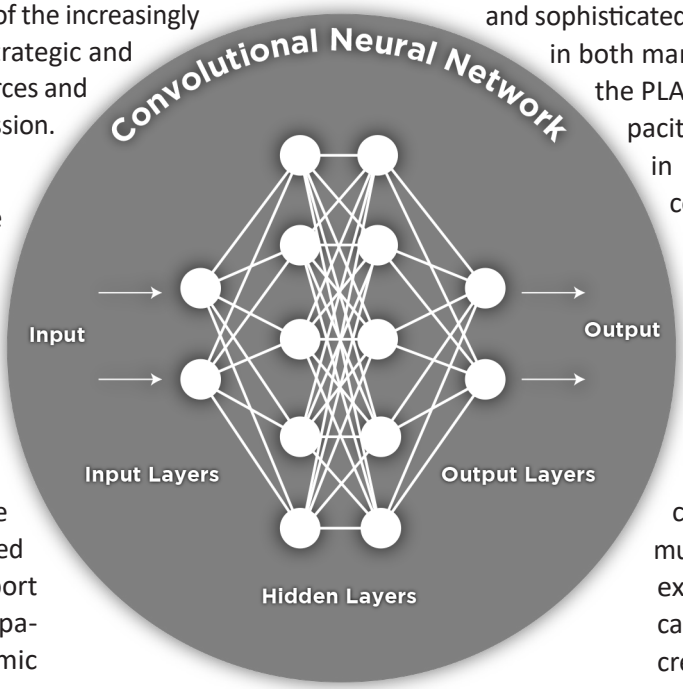
base stations in 2021.[24] These numbers represent commercial 5G deployments, yet as previously mentioned, Chinese military-civil fusion mandates that emerging technologies like 5G also be developed for dual-use military applications.[25]

Chinese military strategists and scientists have also labeled 5G as vital to enhancing C4ISR by increasing machine-to-machine connectivity between sensors while also facilitating human-machine interaction in a complex operating environment.[26] The PLA is unlikely to incorporate commercial 5G standards for military use. Rather, the PLA will leverage the favorable commercial aspects of 5G and subsequent generations for implementation into military applications. China's extensive involvement in the development of next-generation communications standards, combined with military-civil fusion efforts, provides an advantage over the United States.

While no evidence suggests China has successfully fielded an intelligentized weapon system, the conditions are optimal for the PLA to achieve intelligentization before the United States forces. China's technological convergence of artificial intelligence and next-generation communications will aid the ubiquitous fielding of unmanned C4ISR and weapon systems. This will foster a military Internet of Things ecosystem to fulfill accelerated command decision making and targeting by amplifying situational awareness of the increasingly complex battlespace, posing a strategic and tactical threat to United States forces and our ability to deter Chinese aggression.

PLA Intelligentization

Strategically, the convergence of artificial intelligence and next-generation communications provides China with opportunities to better understand United States capabilities and subsequent vulnerabilities. Motivated by the successes of AlphaGo-like artificial intelligence systems and reliant on sophisticated deep learning algorithms to support wargaming and analysis-like capabilities, China can use algorithmic warfare to compete against and potentially outwit United States strategic options. The data bloodlines are already flowing through China with 5G, helping to feed the data-hungry algorithms to foster learning. As China looks to proliferate Chinese-developed 5G technology across the globe as part of the Belt and Road Initiative, an ever-increasing stream of varied data will facilitate artificial intelligence expansion and provide access to a significant portion of the world's data. United States efforts to build partnerships with other nations might serve as a double-edged sword if those nations are also heavily reliant on Chinese telecommunications infrastructure. United States partners may unknowingly enable China to harvest and militarize data for malign influence and intelligent warfare purposes.



A specialized type of artificial Intelligence algorithm that imitates human vision. It can be used for applications involving facial recognition, image analyis, and change detection.[27] (Graphic by MIPB Staff)

With such large datasets made accessible as part of next-generation communications, Chinese artificial intelligence algorithms can develop at a much greater pace and, using military-civil fusion, enable integration into the military Internet of Things ecosystem more rapidly to support intelligent warfare efforts. Tactically, the employment of artificial intelligence in PLA weapon systems and C4ISR can aid in the analytic efforts necessary for targeting U.S. and allied forces. The targeting process is extraordinarily complex and requires a multilayered integration of data to understand the system capabilities of friendly weapon systems and a simultaneous vulnerability analysis of adversary systems to achieve the appropriate effect against a target. In multidomain large-scale combat operations, time is of the essence, requiring nearly instantaneous target identification and analysis of an appropriate effects solution to achieve the commander's objectives. Reliant on next-generation communications infrastructure and sophisticated artificial intelligence algorithms in both manned and unmanned platforms, the PLA will have the capability and capacity to quickly seize the initiative in large-scale combat operations, complicating or even preventing U.S. objectives.

While next-generation communications will enable greater connectivity for machine-to-machine communications, thereby vastly increasing the potential targets for intelligence collection, next-generation communications will present access and exploitation limitations to tactical collection capabilities. This will create a heavy reliance on theater and national intelligence collection capabilities, with an enhanced focus on collecting and targeting the crucial data links providing the connectivity for a PLA military Internet of Things. With greater numbers of connected devices in intelligence warfare, cyberspace will continue to be an increasingly important domain during artificial intelligence-accelerated competition and conflict, providing unique access and opportunities to achieve effects against artificial intelligence-enabled systems.

Photos courtesy of U.S. Air Force

Swarm intelligence or swarm combat offers insight into how the convergence of artificial intelligence and next-generation communications can facilitate tactical intelligent warfare. The TRADOC journal *OE Watch* published an excerpt from the PLA's official publication, *Jiefangjun Bao*, highlighting how the PLA might use massive numbers of unmanned drones for swarming operations, relying on collaboration by networked autonomous systems against an adversary. The drones would either simply overwhelm enemy capabilities through sheer numbers or assign roles to each drone, such as offensive, defensive, or ISR, depending on the mission requirements.[28] Another described method was "mother ship-launched" operations, whereby a centralized manned or unmanned platform serves as the command and control and mobilization effort for multidomain unmanned systems, providing a long-range and versatile coordination capability across multiple locations, and effectively conducting offensive rather than defensive maneuvers.[29]

Countering Chinese Technological Convergence

The question becomes how to counter Chinese artificial intelligence and next-generation communications convergence efforts. At the highest levels, the United States must employ a national strategy using all instruments of power to develop partnerships, incentivize, and build relations with Pacific nations. A whole-of-government effort is necessary to counter Chinese influence in the region and mitigate the expansion of Chinese next-generation communications infrastructure in partner nations to reduce the risk of data used for nefarious purposes. Domestically, the need exists for a greater emphasis on developing indigenous artificial intelligence algorithms to support U.S. military requirements. This requires a combination of military-civil fusion efforts with industry and academia to generate the knowledge and skills necessary in artificial intelligence-related fields like software engineering and data science.

In concert with efforts to integrate data science into the intelligence warfighting function, the Army has implemented initiatives to build literacy in data science and artificial intelligence.[30] One such program is the Army Futures Command "Software Factory," focused on teaching "Soldiers and Civilians how to solve Army problems with cloud technology and modern software, and to better prepare Soldiers for disconnected warfare in 2028 and beyond."[31] These skill-building initiatives scaled to the joint force and combined with insider knowledge of U.S. capabilities, doctrine, and systems will be crucial to integrating artificial intelligence algorithms dynamically to adapt to adversary capabilities in near real time. These efforts, combined with other whole-of-government initiatives, are necessary to counter Chinese artificial intelligence and next-generation communications-enabled threats and win the technology competition through 2035. Failure to act will allow China to realize technological convergence and attain overmatch against United States and allied forces in future multidomain large-scale combat operations.

Endnotes

1. Mallory Shelbourne, "SECDEF Nominee Austin Confirms Threat from China, Will 'Update' National Defense Strategy," USNI News, 19 January 2021, https://news.usni.org/2021/01/19/secdef-nominee-austin-affirms-threat-from-china-will-update-national-defense-strategy.

2. Andrew S. Erickson, "Full Text of 2019 Defense White Paper: 'China's National Defense in the New Era' (English and Chinese Versions)," Andrew Erickson (website), 24 July 2019, https://www.andrewerickson.com/2019/07/full-text-of-defense-white-paper-chinas-national-defense-in-the-new-era-english-chinese-versions.

3. "199. 'Intelligentization' and a Chinese Vision of Future War," *Mad Scientist Laboratory blog*, U.S. Army Training and Doctrine Command (website), December 19, 2019, https://madsciblog.tradoc.army.mil/199-intelligentization-and-a-chinese-vision-of-future-war/.

4. Department of the Army, Training and Doctrine Command (TRADOC) Pamphlet 525-92, *The Operational Environment and the Changing Character of Warfare* (Fort Eustis, VA: TRADOC, 7 October 2019), 13–15.

5. Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2020, Annual Report to Congress* (Washington, DC, 2020), 161.

6. Brett Grossfeld, "Deep learning vs. machine learning: a simple way to learn the difference," *Zendesk blog*, Zendesk, January 23, 2020 (updated November 22, 2021), https://www.zendesk.com/blog/machine-learning-and-deep-learning/; and Michael Middleton, "Deep Learning vs. Machine Learning—What's the Difference?" Flatiron School, February 8, 2021, https://flatironschool.com/blog/deep-learning-vs-machine-learning.

7. Elsa Kania, "AlphaGo and Beyond: The Chinese Military Looks to Future 'Intelligentized' Warfare," Lawfare, June 5, 2017, https://www.lawfareblog.com/alphago-and-beyond-chinese-military-looks-future-intelligentized-warfare.

8. Graham Webster, Rogier Creemers, Paul Triolo, and Elsa Kania, "Full Translation: China's 'New Generation Artificial Intelligence Development Plan' [2017]," *Cybersecurity Initiative* (blog), New America, August 1, 2017, https://www.newamerica.org/cybersecurity-initiative/digichina/blog/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017.

9. Ibid.

10. Ibid.

11. Elsa B. Kania and Lorand Laskai, "Myths and Realities of China's Military-Civil Fusion Strategy," Center for a New American Security, January 28, 2021, https://www.cnas.org/publications/reports/myths-and-realities-of-chinas-military-civil-fusion-strategy.

12. Christopher Moyer, "How Google's AlphaGo Beat a Go World Champion," *The Atlantic*, March 28, 2016, https://www.theatlantic.com/technology/archive/2016/03/the-invisible-opponent/475611/; and James Vincent, "Former Go champion beaten by DeepMind retires after declaring AI invincible," The Verge, November 27, 2019, https://www.theverge.com/2019/11/27/20985260/ai-go-alphago-lee-se-dol-retired-deepmind-defeat.

13. Timothy Thomas, *The Chinese Way of War: How Has it Changed?* (McLean, VA: MITRE Corporation, June 2020), 35–37, https://community.apan.org/cfs-file/__key/docpreview-s/00-00-16-68-30/20200611-China-Way-of-War-_2800_Timothy-Thomas_2900_.pdf.

14. Ibid., 32–34.

15. Edmund J. Burke, Kristen Gunness, Cortez A. Cooper III, and Mark Cozad Burke, *People's Liberation Army Operational Concepts* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/content/dam/rand/pubs/research_reports/RRA300/RRA394-1/RAND_RRA394-1.pdf.

16. Todd South, "New in 2021: The Army's Project Convergence scales up," *Army Times*, January 4, 2021, https://www.armytimes.com/news/your-army/2021/01/04/new-in-2021-the-armys-project-convergence-scales-up.

17. Elsa B. Kania, "Securing our 5G Future," Center for a New American Security, November 7, 2019, https://www.cnas.org/publications/reports/securing-our-5g-future.

18. Amy Nordrum and Kristen Clark, "Everything You Need to Know About 5G," IEEE Spectrum, 27 January 2017, https://spectrum.ieee.org/video/telecom/wireless/everything-you-need-to-know-about-5g.

19. Ibid.

20. Ibid.

21. United States–China Economic and Security Review Commission, *2020 Report to Congress of the U.S.-China Economic and Security Review Commission* (Washington, DC, 2020), 51, https://www.uscc.gov/sites/default/files/2020-12/2020_Annual_Report_to_Congress.pdf.

22. Ibid., 212.

23. Ibid.

24. Robert Clark, "China 5G still immature, says think tank," Light Reading, January 7, 2021, https://www.lightreading.com/asia/china-5g-still-immature-says-think-tank/d/d-id/766457.

25. Kania and Laskai, "Myths and Realities."

26. Elsa B. Kania, " 'AI Weapons' in China's military innovation," *Brookings Institution*, April 2020, https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_ai_weapons_kania.pdf.

27. Avijeet Biswal, "Convolutional Neural Network Tutorial," AI & Machine Learning, Simplilearn, last updated February 21, 2022, https://www.simplilearn.com/tutorials/deep-learning-tutorial/convolutional-neural-network.

28. Cindy Hurst, "China: 'New Concepts' in Unmanned Combat," *OE Watch* 10, no. 10 (October 2020): 37–38.

29. Ibid.

30. Jason Boslaugh and Zachary Kendrick, "The Application of Data Science in the Intelligence Warfighting Function," *Military Intelligence Professional Bulletin* 45, no. 4 (October–December 2019): 57–63.

31. Army Futures Command, "AFC Announces 'Software Factory' in Austin," Army.mil, July 14, 2020, https://www.army.mil/article/237265/afc_announces_software_factory_in_austin.

CW5 Jason Kinsey serves as the 352S, Signals Collection Technician, Warrant Officer Basic Course manager/instructor with the 304th Military Intelligence (MI) Battalion at Fort Huachuca, AZ. He was previously assigned to the 706th MI Group at Fort Gordon, GA, where he served as a division chief for the Emerging and Anticipatory Technologies office at the National Security Agency/Central Security Service Georgia. He has over 20 years of signals intelligence experience at a variety of assignments in the continental United States and overseas and holds a master of science in strategic intelligence from the National Intelligence University.