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China's Approach to Military 5G Networks and Related Military Applications

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1. Introduction

China's pursuit of 5G technology for geopolitical ends, such as financial assistance to the Chinese telecommunications firm Huawei, has been well documented.¹ 5G refers to the fifth generation of mobile networking technology. It offers increased data transmission speeds, lower latency, and greater connectivity enabled through the new capabilities that 5G technology brings, including enhanced mobile broadband (eMBB), ultra-reliable and low-latency communications (URLLC), and massive machine-type communications (mMTC).² China's development and rollout of Huawei 5G networks globally has created supply chain and network security risks for NATO and EU member states.³ While many states have begun to respond to the challenges associated with untrusted networks, China's actions are not limited to economic competition or influence. In 2019, Chinese scholars and researchers linked to China's military, hereinafter also the People's Liberation Army (PLA), argued that 5G has 'strong military application value' and advocated for a comprehensive '5G technology development strategy' for military use.⁴ China's interest in 5G technologies for dual-use and military ends has advanced beyond mere discussions. The PLA has been working to integrate 5G and next-generation communication networks⁵ within its military modernization process. In one 'national defence mobilization' drill, the PLA used mobile 5G networks to maintain emergency communications during a network failure scenario.⁶ China's defence industry has also developed capabilities for 5G-enabled military communications.⁷ As China's domestic rollout of 5G networks

¹ Chuin-Wei Yap, 'State Support Helped Fuel Huawei's Global Rise', *Wall Street Journal*, 25 December 2019, <https://www.wsj.com/articles/state-support-helped-fuel-huaweis-global-rise-11577280736>.

² 'IMT Vision: Framework and Overall Objectives of the Future Development of IMT for 2020 and Beyond. Recommendation M.2083-0 (09/2015)', International Telecommunication Union, 29 September 2015, <https://www.itu.int/rec/R-REC-M.2083-0-201509-I/en>. For an overview of military 5G, see Piret Pernik et al., *Research Report Supply Chain and Network Security for Military 5G Networks* (Tallinn: NATO CCDCOE, 2021).

³ For example, see Alex Rubin et al., 'The Huawei Moment', Center for Security and Emerging Technology, July 2021, <https://cset.georgetown.edu/publication/the-huawei-moment/>; Elsa B. Kania, 'Securing Our 5G Future: The Competitive Challenge and Considerations for U.S. Policy', Center for a New American Security, 7 November 2019, <https://www.cnas.org/publications/reports/securing-our-5g-future>.

⁴ Guo Chao [郭超], Yu Chuanxin [于川信], and Wang Jingfang [王景芳], 'Some Considerations on the Military Application of the Fifth-Generation Mobile Communication Technology' [对第五代移动通信技术军事应用的几点认识], *National Defence* [国防] (2019), <https://archive.ph/JvtMc>.

⁵ This report uses the term 'next-generation communication networks' to refer to advanced networking technology sometimes termed 'Beyond 5G' or '6G' technologies.

⁶ CCTV [央视网], 'Communication Is Paralyzed: Can the PLA Use 5G to Resume Command? This Video Tells the Truth' [通讯陷入瘫痪，解放军能不能用 5G 恢复指挥？这段视频说出真相], 17 June 2019, <https://archive.ph/YZvdJ>.

⁷ Elsa B. Kania, 'Why China's Military Wants to Beat the US to a Next-Gen Cell Network', *Defense One*, 8 January 2019, <https://www.defenseone.com/ideas/2019/01/why-chinas-military-wants-beat-us-next-gen-cell-network/154009/>.

continues, the PLA and China's defence industry will continue to integrate next-generation communication networks to gain a military edge.⁸

China's advancement of 5G for military use has important security implications for NATO member states. Unlike emerging technologies such as quantum technologies that may be years away from widespread military adoption and use,⁹ 5G and next-generation communication networks are already being developed and implemented by armed forces. In 2020, the United States Department of Defense (DoD) treated 5G as a 'critical strategic technology' that will bring long-term military advantages,¹⁰ and announced over \$600 million for 5G experimentation and testing. More recently, NATO has launched multinational programmes to develop scenarios and map opportunities and challenges for 5G.¹¹ NATO has also incubated broader innovation initiatives like the NATO Innovation Fund¹² and the Defence Innovation Accelerator for the North Atlantic (DIANA).¹³ These and other similar developments represent a significant effort by NATO member states to begin to incorporate 5G and new technologies within mission and operational environments. Importantly, 5G is likely to accelerate the adoption of technologies like artificial intelligence (AI) and enable new opportunities to coordinate technological assets on the battlefield. In many ways, 5G-enabled integration of these technologies will define the future of warfighting. As the DoD concluded in 2018, 'Success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting'.¹⁴

⁸ See, for example, arguments in PLA-linked newspapers cited by Rush Doshi et al., 'China as a "Cyber Great Power": Beijing's Two Voices in Telecommunication', Brookings Institution, April 2021, <https://www.brookings.edu/research/china-as-a-cyber-great-power-beijings-two-voices-in-telecommunications/>.

⁹ Jon Bateman, 'Maintaining a Military Edge Over China', in *U.S.-China Technological 'Decoupling': A Strategy and Policy Framework*, Carnegie Endowment for International Peace, April 2022, <https://carnegieendowment.org/2022/04/25/maintaining-military-edge-over-china-pub-86901>.

¹⁰ Congress directed the Defense Department to develop a 5G strategy in Section 254 of the FY2020 National Defense Authorization Act (NDAA). United States Department of Defense, 'Department of Defense (DoD) 5G Strategy', May 2020, <https://apps.dtic.mil/sti/citations/AD1122854>. See also 'National Security Implications of Fifth Generation (5G) Mobile Technologies', Congressional Research Service, 4 June 2021, <https://fas.org/sqp/crs/natsec/IF11251.pdf>.

¹¹ NATO Communications and Information Agency (NCI Agency), 'Multinational Collaboration on 5G', <https://www.mindev.gov.gr/wp-content/uploads/2020/11/Enclosure-3-Leaflet-Multinational-Collaboration-on-5G.pdf>.

¹² 'NATO launches Innovation Fund', NATO, 30 June 2022, https://www.nato.int/cps/en/natohq/news_197494.htm.

¹³ According to Antonio Calderon, interim CTO for the NCI Agency, '5G could be a good candidate for one of those defense challenges that maybe DIANA ... could address.' See Vivienne Machi, 'NATO Wants a Say in 5G Standardization Talks', Defense News, 22 March 2022, <https://www.defensenews.com/battlefield-tech/it-networks/5g/2022/03/22/nato-wants-a-say-in-5g-standardization-talks/>.

¹⁴ United States Department of Defense, '2018 National Defense Strategy', January 2018, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>. The recent NATO science and technology trend analysis on emerging and disruptive technologies also does not discuss 5G in depth. NATO Science & Technology Organization, 'Science & Technology Trends 2020-2040', 2020, https://www.nato.int/nato_static_fl2014/assets/pdf/2020/4/pdf/190422-ST_Tech_Trends_Report_2020-2040.pdf.

Despite the expected role for 5G in future military contexts, there has not yet been a comprehensive analysis of military 5G developments. As a general matter, experts have described military 5G as an overlooked area of study.¹⁵ More specifically, discussions of China's emerging and disruptive technologies have focused on AI and other technologies.¹⁶ Finally, in part due to the spotlight on Huawei and the commercial rollout of 5G, comprehensive analyses of China's military capabilities have often left 5G and next-generation communication networks behind.¹⁷ China's pursuit of 5G and next-generation communication networks for national security and military purposes has not yet been explored in detail. As the NATO 2022 Strategic Concept explains, China has sought to 'increase its global footprint and project power, while remaining opaque about its strategy, intentions and military build-up'.¹⁸ This paper will argue that China's activities in the rollout of 5G represent a concerted effort to advance its military capabilities, support the mobilization of its armed forces, and compete for technological and military advantage. In doing so, the article addresses the 'opaqueness' of China's military ambitions by explicating China's military 5G aims, strategies, and innovations.

This paper describes China's overall approach to 5G and the modernization of its military, contributing to a better understanding of how China's military and domestic security services might leverage 5G capabilities. A variety of sources will be analysed, including official strategy documents, articles and essays by government officials and PLA-linked scholars, and commercial documents like due diligence and market analysis reports. Official sources can reveal society-wide efforts like 'informatization', which touch upon virtually every aspect of Chinese economic, political, and military programmes.¹⁹ Unofficial sources, such as academic publications and newspapers linked to the PLA can add additional context. While unofficial sources are not an indication of government views, they can reveal China's ambitions around 5G in more

¹⁵ Erica D. Borghard and Shawn W. Lonergan, 'The Overlooked Military Implications of the 5G Debate', Council on Foreign Relations, 25 April 2019, <https://www.cfr.org/blog/overlooked-military-implications-5g-debate>.

¹⁶ Jieruo Li, 'Artificial Intelligence Technology and China's Defense System', *Journal of Indo-Pacific Affairs* (1 April 2022), <https://www.airuniversity.af.edu/JIPA/Display/Article/2980879/artificial-intelligence-technology-and-chinas-defense-system/>; Elsa B. Kania, "AI weapons" in China's military innovation', Brookings Institution, April 2020, <https://www.brookings.edu/research/ai-weapons-in-chinas-military-innovation/>.

¹⁷ United States Department of Defense, 'Military and Security Developments Involving the People's Republic of China 2021', November 2021, <https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF>. See also United States Department of Defense, 'Military and Security Developments Involving the People's Republic of China 2022', November 2022, <https://www.defense.gov/CMPR/>.

¹⁸ NATO, 'NATO 2022 Strategic Concept', 30 June 2022, <https://www.nato.int/strategic-concept/>.

¹⁹ Charles Rybeck et al., 'Applying America's Superpowers: How the U.S. Should Respond to China's Informatization Strategy', War on the Rocks, 19 September 2018, <https://warontherocks.com/2018/09/applying-americas-superpowers-how-the-u-s-should-respond-to-chinas-informatization-strategy/>.

detail. As a 2020 report from the Brookings Institution explains, President Xi Jinping and other high-level government officials are unlikely to discuss specific technologies, and sensitive topics like the military applications of 5G are not discussed in government documents.²⁰ No analysis of China's emerging technology sector can capture sensitive or classified activities, such as investments by China's military. Still, this paper aims to present available sources, which may reveal important insights about the current landscape of military 5G within China.

²⁰ Doshi et al., 'China as a "Cyber Great Power"'.

2. China's Plans and Aims for 5G Development

Unlike the United States, China has not released a comprehensive 5G strategy for its military. It is not entirely accurate to speak of China's military 5G strategy—if there is such a strategy, it is not publicly accessible. Instead, this paper describes China's overall approach to developing applications based on 5G, with specific attention to discussions of dual-use technologies and military 5G. In doing so, it aims to reveal China's strategic and competitive ambitions for 5G, including the possible future uses of 5G in mission and operational settings. In order to understand China's aims and ambitions towards military 5G, it is necessary to first consider the theoretical developments and strategic principles that serve as the backdrop to the Chinese Communist Party's (CCP) policy-making apparatus—for example, President Xi's goal for the PLA to become a 'world-class military' [世界一流军队]. Two aspects of China's strategic vision are discussed in this section: concepts, such as 'informatization' [信息化] and 'military-civil fusion' (MCF) [军民融合], that structure China's overall aims and ambitions towards 5G; objectives, including the national goals set out in the '14th Five-Year Plan' (2021) and the more specific follow-up '14th Five-Year Plan for National Informatization' (2021), that define China's approach to military 5G.

2.1 Guiding Concepts: Informatization, Networkization, Intelligentization and Military-Civil Fusion

The society-wide concept of 'informatization' gained traction in Chinese policy circles as early as the first decade of the 2000s.²¹ Beginning under President Hu Jintao, who was in power from 2002 to 2012, Chinese officials have recognized the importance of informatization as an overarching strategy for ensuring economic development and national security. In the current era, President Xi has called for informatizing almost every aspect of society, from the military to the government and the broader economy.²² On the current view, 'informatization' refers to the application of digital technology to all aspects of Chinese society, from the digitization of government services to technology-driven approaches to military mobilization.²³ The term

²¹ John Costello and McReynolds, 'China's Strategic Support Force: A Force for a New Era', National Defense University, 2018, https://ndupress.ndu.edu/Portals/68/Documents/stratperspective/china/china-perspectives_13.pdf.

²² Charles Rybeck et al., 'Applying America's Superpowers'.

²³ Katja Drinhausen and John Lee, 'The CCP in 2021: Smart Governance, Cyber Sovereignty and Tech Supremacy', MERICS, 15 June 2021, <https://merics.org/en/ccp-2021-smart-governance-cyber-sovereignty-and-tech-supremacy>.

‘informatization’ is often used in the context of societal digital transformation, and Chinese strategists and military officials have championed informatization as a key goal of the PLA. According to Major General Wang Kebin, who headed the PLA’s Informatization Department, informatization has three phases: ‘digitalization’, ‘networkization’, and ‘intelligentization’.²⁴ Early efforts in reforming the PLA focused on digital and network modernization. After witnessing United States military activities during the 1991 Gulf War, PLA strategists began to consider how the integration of information technology could lead to military superiority, referencing the use of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR).²⁵ Reports from China’s official state news agency Xinhua acknowledge that China, compared to the United States, was a latecomer to military digitization.²⁶ During this time, military concepts like ‘integrated network and electronic warfare’ (INEW) [网电一体战] emerged in China’s national security policy community. And to address this perceived lack of modernization, the PLA undertook significant advancements in modernizing its C4ISR systems and developing offensive cyber capabilities throughout the first decade of the 2000s.²⁷ These efforts constituted dramatic advances in ‘digitization’ and ‘networkization’. Now, the PLA has focused its attention on ‘intelligentization’, viewing advances in AI and 5G as a way of leapfrogging over its opponents in terms of military capabilities.²⁸ As part of MCF, 5G is viewed as supporting military force mobilization and informatization-driven military modernization.²⁹ According to one Chinese scholar, 5G networks could help improve ‘wartime logistics’ through smart warehouses.³⁰

²⁴ Elsa B. Kania and John Costello, ‘China’s Quest for Informatization Drives PLA Reforms’, *Diplomat*, 4 March 2017, <https://thediplomat.com/2017/03/chinas-quest-for-informatization-drives-pla-reforms/>.

²⁵ See Joe McReynolds and James C. Mulvenon, ‘The Role of Informatization in the People’s Liberation Army under Hu Jintao’, in *Assessing the People’s Liberation Army in the Hu Jintao Era*, ed. Roy Kamphausen, David Lai, and Travis Tanner (Carlisle Barracks, PA: Strategic Studies Institute, April 2014), 207–256.

²⁶ Xinhua News Agency [新华社], ‘See the First Informatization Unit of the PLA’ [探访中国陆军第一支信息化部队], 14 August 2016, <https://archive.ph/sqZrt>.

²⁷ Costello and McReynolds, ‘China’s Strategic Support Force: A Force for a New Era’.

²⁸ Ben Noon and Chris Bassler, ‘How Chinese Strategists Think AI Will Power a Military Leap Ahead’, *Defense One*, 17 September 2021, <https://www.defenseone.com/ideas/2021/09/how-chinese-strategists-think-ai-will-power-military-leap-ahead/185409/>.

²⁹ Larry M. Wortzel, ‘Military Mobilization in Communist China’, Association of the United States Army, 18 December 2020, <https://www.ausa.org/publications/military-mobilization-communist-china>.

³⁰ Xue Zhiliang [薛志亮], ‘How national defense mobilization embraces the 5G era’ [国防动员如何拥抱 5G 时代], <https://archive.ph/PKrgB>. Compare Colin Demarest, ‘AT&T Demonstrates 5G Capability for US Navy “Smart Warehouse”’, *Defense News*, 10 June 2022, <https://www.defensenews.com/naval/2022/06/10/att-demonstrates-5g-capability-for-us-navy-smart-warehouse/>.

Within this broader digital transformation, President Xi has called for ‘MCF in informatization’ in public speeches.³¹ As experts have explained, MCF refers to the cultivation of stronger links between China’s civilian sector and defence-industrial base.³² In the context of this paper, MCF, which enables the Chinese military to benefit from the civilian economy and infrastructure,³³ is seen as the integration between telecommunication firms and the developers of military applications of 5G. Even as China’s foreign ministry officials downplay the relationship between Huawei and state entities,³⁴ CCP officials think and speak about 5G in the context of national security and geostrategic frames. Chinese strategists have long understood 5G as a gateway to China’s ambitions as a ‘cyber great power’ [网络强国] and as an opportunity for advancing China’s interests in great-power competition with the United States.³⁵ More concretely, Chinese telecommunication companies, such as China Mobile, have entered into cooperation agreements with PLA combatant commands to integrate and promote innovation in 5G, as discussed in more detail in Section 5 of this paper.³⁶ Thus, China’s developments in MCF require understanding not only ‘top-down’³⁷ reforms and initiatives linked to the PLA and state entities but also activities related to its defence-industrial base, civilian technology sector, and PLA-linked research institutions.

2.2 National Plans for 5G Development

The discussion of 5G innovation within China’s national strategy documents indicates important aspects of China’s aims and ambitions for military 5G. Dating back to the Maoist era, China’s ‘five-year plans’ set key national priorities. In the current era, these plans do not set production quotas but provide party leadership, local officials, and

³¹ Rogier Creemers, ‘Xi Jinping’s Speech at the National Cybersecurity and Informatization Work Conference’, DigiChina, 22 April 2018, <https://digichina.stanford.edu/work/xi-jinpings-speech-at-the-national-cybersecurity-and-informatization-work-conference/>.

³² Elsa B. Kania and Lorand Laskai, ‘Myths and Realities of China’s Military-Civil Fusion Strategy’, Center for a New American Security, 28 January 2021, <https://www.cnas.org/publications/reports/myths-and-realities-of-chinas-military-civil-fusion-strategy>.

³³ Elsa B. Kania, ‘Why China’s Military Wants to Beat the US to a Next-Gen Cell Network’.

³⁴ Ministry of Foreign Affairs of the People’s Republic of China, ‘Foreign Ministry Spokesperson Hua Chunying’s Regular Press Conference on September 27, 2021’, <https://archive.ph/ZcWVG>.

³⁵ Doshi et al., ‘China as a “Cyber Great Power”’.

³⁶ ‘Zhejiang Mobile and the Naval Staff Department of the Eastern Theater Command Work Together to Promote the Development of Military-Civil Fusion in the 5G Era’ [浙江移动与东部战区海军参谋部携手合作，推动 5G 时代军民融合发展], 21 July 2021, <https://archive.ph/LMPAi>.

³⁷ Nis Grünberg and Katja Drinhausen, ‘The Party Leads on Everything: China’s Changing Governance in Xi Jinping’s New Era’, MERICS, 2019, <https://merics.org/en/report/party-leads-everything>.

public- and private-sector companies with a wide set of targets and objectives.³⁸ While light on specific regulations and guidelines, these documents serve as a window to understand CCP decision-making in the near term. In the most recent strategic plan, the ‘14th Five-Year Plan’ (2021), 5G is mentioned at several points, with multiple references to 5G for infrastructure modernization and industrial applications.³⁹ The document highlights industry verticals for 5G applications, including transportation, logistics, health, and energy. Importantly, 5G is not envisioned as a standalone technology (e.g., solely for telecommunications) but also as a way of ‘informatizing’ the industry verticals mentioned above that are prefixed with the term ‘intelligent’. At the end of 2021, a more specific strategy document, titled the ‘14th Five-Year Plan for National Informatization’, was released.⁴⁰ This document uses the term ‘5G’ much more frequently than the ‘14th Five-Year Plan’ does. The informatization plan reiterated the need to adopt 5G in vertical industries and called for increasing research on ‘key technologies’ related to network infrastructure, such as satellite communications. The informatization plan also detailed the need to demonstrate applications of smart network systems, including smart ports ‘based on technologies such as 5G, [the] BeiDou [Global Navigation Satellite System] and the Internet of Things (IoT)’, smart vehicles and autonomous capabilities through ‘5G-V2X (vehicle-to-everything) networking’, and smart power-grid architectures.⁴¹

China’s five-year plans have informed its nationwide 5G rollout and its vision for innovation in 5G-related applications. According to government sources, China has installed over one and a half million 5G base stations, reaching an estimated half a billion users.⁴² By 2025, China expects to build over three million base stations, with a

³⁸ ‘What Is China’s Five-Year Plan?’, *Economist*, 4 March 2021, <https://www.economist.com/the-economist-explains/2021/03/04/what-is-chinas-five-year-plan>.

³⁹ Ben Murphy, ‘Translation: China’s 14th Five-Year Plan’, Center for Security and Emerging Technology, 12 May 2021, https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf; the original version is ‘Outline of the People’s Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035’ [中华人民共和国国民经济和社会发展第十四个五年规划和 2035 年远景目标纲要], http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm.

⁴⁰ In general, China’s Five-Year Plans provide a comprehensive overview of the nation’s goals. Specific plans such as the Five-Year Plan for National Informatization provide more specific objectives. See Rogier Creemers et al., ‘Translation: 14th Five-Year Plan for National Informatization – Dec. 2021’, DigiChina, 24 January 2022, <https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/>; the original version is ‘14th Five-Year Plan for National Informatization’ [“十四五” 国家信息化规划], <https://www.gov.cn/xinwen/2021-12/28/5664873/files/1760823a103e4d75ac681564fe481af4.pdf>.

⁴¹ Rogier Creemers et al., ‘Translation: 14th Five-Year Plan’.

⁴² Iris Deng, ‘China Targets 2 Million Installed 5G Base Stations This Year, Expanding World’s Biggest Next-Generation Mobile Network, as 6G Preparations Push Ahead’, *South China Morning Post*, 9 March 2022, <https://www.scmp.com/tech/policy/article/3169832/china-targets-2-million-installed-5g-base-stations-year-expanding>.

total 5G investment of over \$400 billion.⁴³ China's initial efforts focused on non-standalone 5G, building on the existing 4G LTE core network. These efforts enabled faster data transmission speeds but without the URLLC and mMTC benefits of standalone 5G.⁴⁴ Current efforts, however, have dramatically expanded China's deployment of standalone 5G, which can enable industry verticals using 5G and potential dual-use (military and civilian) applications.⁴⁵ Table I lists China's lines of effort for 'innovative 5G applications', as articulated in the '14th Five-Year Plan for National Informatization'.

Table I: China's Lines of Effort for 'Innovative 5G Applications'⁴⁶

<i>Accelerate the 5G network rollout</i>	<ul style="list-style-type: none"> • Coordinate 5G network layout and extend coverage to key cities and towns. • Build a safety protection system for 5G development and application. • Strengthen 5G supply chain security.
<i>Develop an ecosystem for 5G applications</i>	<ul style="list-style-type: none"> • Promote the development, utilization, and application of 5G in industry verticals. • Strengthen audio and video transmission capabilities based on 5G networks. • Promote the 'public 5G high-speed rail'.
<i>Promote innovation in 5G</i>	<ul style="list-style-type: none"> • Strengthen research on 5G technical standards and applications with industry partners. • Accelerate the research, development, and industrialization of key components of 5G networks. • Continue millimeter wave technology research and testing.

Beijing's long-term priorities include developing an ecosystem for 5G pilot applications and promoting innovation in 5G through research and development and industrialization led by state institutions, such as the Ministry of Industry and Information Technology. However, military 5G is not explicitly mentioned in the government documents mentioned above.⁴⁷

The reason why China does not have an apparent strategy for military 5G lies with its approach to 5G-related application development. Here, it is helpful to contrast the US

⁴³ Deloitte, '5G Deployment: The Chance to Lead for a Decade', *Deloitte Perspectives* (2018), <https://www2.deloitte.com/us/en/pages/consulting/articles/5G-deployment-for-us.html>.

⁴⁴ 'URLLC' is ultra-reliable and low latency communications, and 'mMTC' is massive machine-to-machine communications.

⁴⁵ Paul Triolo, 'China's 5G Strategy: Be First Out of the Gate and Ready to Innovate', Center for Strategic and International Studies, 1 February 2020, <https://www.jstor.org/stable/resrep22605.10>.

⁴⁶ Rogier Creemers et al., 'Translation: 14th Five-Year Plan'. The original text is edited for length and clarity.

⁴⁷ Ben Murphy, 'Translation: China's 14th Five-Year Plan'; Rogier Creemers et al., 'Translation: 14th Five-Year Plan'.

approach, illustrated by documents like the DoD's '5G Strategy' and '5G Strategy Implementation Plan'.⁴⁸ Instead of defining a specific 5G strategy for its military, China's leaders have prioritized the domestic rollout of 5G, with the eventual goal of developing a wide-ranging, multi-sector innovation pipeline for developing 5G applications. But this is not to say that the PLA and domestic security services have not pursued military 5G capabilities. With China's strategy of MCF, there is no sharp divide between 5G-related civilian and military applications, and most modern technology is dual-use. Consider examples of technologies mentioned in the national informatization plan with potential military applications: network infrastructure for precise navigation, emergency response networks, and secure communications.⁴⁹

China's national informatization plan also discusses communication networks in the context of public safety and domestic surveillance, calling for building 'integrated command and communications systems' [一体化指挥通信体系] for law enforcement.⁵⁰ Commercial suppliers of domestic surveillance equipment for law enforcement have been linked with branches of the PLA,⁵¹ leveraging dual-use technology from the private sector for military use as per MCF. Likewise, the Chinese government, military, and law enforcement collaborate closely on the development and operation of the domestic surveillance infrastructure in Xinjiang.⁵²

In addition, as researchers at Brookings have explained, Beijing downplays 5G-related security concerns abroad but emphasizes similar concerns domestically. Recently, China's Ministry of Foreign Affairs spokesperson Hua Chuying accused the US of stretching the concept of national security to unfairly target Chinese firms like Huawei.⁵³ But China's government documents, like the national plan for informatization,

⁴⁸ 'Department of Defense (DoD) 5G Strategy'; United States Department of Defense, 'Department of Defense 5G Strategy Implementation Plan', December 2020, <https://www.cto.mil/wp-content/uploads/2020/12/DOD-5G-Strategy-Implementation-Plan.pdf>.

⁴⁹ See Elsa B. Kania, 'Securing Our 5G Future: The Competitive Challenge and Considerations for U.S. Policy'. 5G could contribute to information support, new mechanisms for command and control, and the integration of drones.

⁵⁰ Rogier Creemers et al., 'Translation: 14th Five-Year Plan'. While these networks are not 5G specific, future surveillance networks could incorporate 5G.

⁵¹ Dan Strumpf, 'Chinese Surveillance-Gear Maker Hikvision Has Ties to Country's Military, Report Says', *Wall Street Journal*, 25 May 2021, <https://www.wsj.com/articles/chinese-surveillance-gear-maker-hikvision-has-ties-to-countrys-military-report-says-11621941983>.

⁵² Dahlia Peterson, 'How China Harnesses Data Fusion to Make Sense of Surveillance Data', Brookings Institution, 23 September 2021, <https://www.brookings.edu/techstream/how-china-harnesses-data-fusion-to-make-sense-of-surveillance-data/>.

⁵³ 'China Accuses U.S. Using "National Security" as Excuse to Act against Chinese Firms', Reuters, 1 September 2020, <https://www.reuters.com/article/us-usa-china-military-idUSKBN25S4Q8>.

highlight the need to strengthen 5G supply chain security domestically [5G 供应链安全管理],⁵⁴ and China's leaders implicitly reference concerns with foreign dependence in calling for the development of 5G network components. This is perhaps not surprising given that the US export controls on chipsets and other advanced technologies are expected to negatively impact China's ability to produce and deploy 5G.⁵⁵ In this regard, the lack of discussion of military 5G in government documents might represent an attempt to downplay China's role in the 'militarization' of 5G and alleviate security concerns foreign audiences might have in relation to Chinese firms' cooperation with CCP.

2.3 Discussions of Military 5G

While China's government strategy documents do not detail a role for the PLA in the development of 5G, discussions in military writings indicate substantial interest in leveraging 5G for military modernization goals. In a recent academic paper, researchers affiliated with the PLA's Army Engineering University⁵⁶ highlight both strategic and technical discussions.⁵⁷ At a high level, researchers linked to the PLA have discussed how 5G networks might enable military applications (industry verticals in the civilian context), including mission-critical communications, tactical communication networks, and navigation.⁵⁸ Next-generation communication networks enable additional advances in deploying emerging and disruptive technologies for military use, in areas such as robotics, AI, and unmanned platforms.

2.3.1 5G Technology as an Enabler of New Technologies

First, macro-level discussions in PLA-linked publications treat military 5G networks as a key enabler of emerging and disruptive technologies like AI. For instance, in a 2019 issue of the Chinese journal *National Defence*, Guo Chao et al. highlighted the strategic value of military applications for 5G networks and called for additional

⁵⁴ '14th Five-Year Plan for National Informatization', 14.

⁵⁵ 'Can Huawei Thrive Despite American Sanctions?', *Economist*, 25 October 2022, <https://www.economist.com/business/2022/10/25/ren-zhengfei-has-big-plans-for-huawei-in-spite-of-american-sanctions>.

⁵⁶ Australian Strategic Policy Institute, China Defense Universities Tracker, 'Army Engineering University', <https://unitracker.aspi.org.au/universities/army-engineering-university/>.

⁵⁷ Han Songyue [韩松岳] et al., 'Research on Military Application of 5G Mobile Communication Technology' [5G 移动通信技术军事应用研究], *Ordnance Industry Automation* 41(4) (April 2022).

⁵⁸ Han Songyue [韩松岳] et al.

research to ‘formulate our army’s 5G technology development strategy’.⁵⁹ Also in 2019, an article in the *People’s Liberation Army Daily* called for ‘letting 5G empower the military’.⁶⁰ The article explained that ‘by integrating 5G, the performance of a military communication network can be greatly enhanced through improving the amount of information, and autonomous and intelligent capabilities’. 5G is thus seen as critical to the overall process of military ‘intelligentization’ and development. In another newspaper article discussing the strategic value of military 5G networks, officers and scholars at the Chinese Academy of Military Sciences concede that while the development of military 5G networks has challenges, the military applications to be developed are ‘of great strategic significance’.⁶¹

2.3.2 5G Technology for Military Applications

Most writings have focused on the theoretical and hypothetical value of potential future military 5G. However, some Chinese researchers have identified and analysed a range of use cases from tactical military communications for naval operations to other types of military communications, and they have suggested specific examples of military applications in maritime environments.⁶² In many of these discussions, Chinese sources begin with an analysis of efforts by the United States and other NATO nations, which may indicate a perception that these nations are advancing faster than China in the military domain.⁶³ Chinese researchers have recognized the need to leverage China’s civilian expertise in 5G networks for military purposes, something that does not seem to have occurred at a substantial level within China so far. For example, in a recent academic paper, Chinese researchers wrote that a non-tactical military communication system and dual-use infrastructure sites could ‘directly rely on the civilian 5G network’.⁶⁴ However, few articles have been published on the technical front, despite ongoing work at China’s PLA-linked research centres.⁶⁵ The lack of technical research may indicate that the development, experimentation, prototyping, and testing of 5G-related military applications is still in early phases.

⁵⁹ Guo Chao [郭超] et al., ‘Some Considerations’.

⁶⁰ ‘Let 5G Empower the Military’ [让 5G 为军事赋能], *PLA Daily* [解放军报], 22 November 2019, <https://archive.ph/NuqMv>.

⁶¹ Guo Chao et al., ‘Some Considerations’.

⁶² Lin Lina [林丽娜] and Song Yueming [宋越明], ‘Naval Military 5G Application Research’ [海军 5G 军事化应用研究], *Communications Technology* [通信技术] (2020), <https://archive.ph/GMf6b>.

⁶³ See, for example, Guo Chao et al., ‘Some Considerations’; Han Songyue et al., ‘Research on Military Application of 5G Mobile Communication Technology’.

⁶⁴ Lin Lina and Song Yueming, ‘Naval Military 5G Application Research’.

⁶⁵ See Han Songyue et al., ‘Research on Military Application of 5G Mobile Communication Technology’.

3. Possible Priority Areas for Military 5G Applications

In the writings by PLA officers and researchers discussed above, several priority areas for military 5G networks are identified. This section presents a brief survey of the commonly mentioned domains for military 5G networks in Chinese publications. While not a comprehensive summary of all possible use cases, this section nevertheless provides an overview of some of the likely possibilities for future military applications.

3.1 Military Communications, and Command and Control

Sun Bolin, a high-ranking officer in the PLA and the Director of the Military Operations Research Institute of China's premier military science institution, the PLA Academy of Military Sciences [中国人民解放军军事科学院],⁶⁶ summarized the value of an advanced network for military communications in an article from 2020.⁶⁷ As he explains, '5G communication technology will provide the military with an integrated air-ground information communication network with wide-area coverage, high-speed transmission, and the ability to connect additional devices, thereby greatly improving battlefield information support capability'.⁶⁸ While technical issues related to the development of military 5G networks (such as radio frequency spectrum sharing or network slicing) are rarely mentioned in overviews of military 5G use cases, Chinese strategists see 5G technology as the future of military command and control. Experts at one of the PLA's best-funded research institutions, the National Defence Technology University [中国人民解放军国防科技大学]⁶⁹ state that '5G makes a qualitative leap in transmission rate and stability, which can meet the needs of future battlefield communication tasks'.⁷⁰ Enhanced data transmission and massive machine communications can enable greater 'battlefield situational awareness, equipment support, and equipment

⁶⁶ Joel Wuthnow, 'China's "New" Academy of Military Science: A Revolution in Theoretical Affairs?', *China Brief*, 18 January 2019, <https://jamestown.org/program/chinas-new-academy-of-military-science-a-revolution-in-theoretical-affairs/>. See also Australian Strategic Policy Institute, China Defense Universities Tracker, 'Academy of Military Science', <https://unitracker.aspi.org.au/universities/academy-of-military-science/>.

⁶⁷ Sun Bolin [孙柏林], '5G Empowers the Modern Military' [5G 赋能现代军事], *Computer Simulation* [计算机仿真] 37(01) (2020): 1–6.

⁶⁸ Sun Bolin [孙柏林], '5G Empowers the Modern Military' [5G 赋能现代军事]; discussed in Doshi et al., 'China as a "Cyber Great Power"', 12.

⁶⁹ Australian Strategic Policy Institute, China Defense Universities Tracker, 'National University of Defense Technology', <https://unitracker.aspi.org.au/universities/national-university-of-defense-technology/>.

⁷⁰ Bi Xing [毕兴] et al., '5G is coming? Experts at the National University of Defense Technology Show You the 5G Future' [5G 来了? ! 国防科大专家带你畅游 5G 未来], *National University of Defense Technology*, December 2019, <https://archive.ph/5vpit>.

management'.⁷¹ These considerations support discussions by PLA officers on 'informationized' warfighting strategies, which 'refers to a force that employs networks, digital communications technology, and intelligent equipment'.⁷² One specific future use of 5G networks is to enhance maritime communications (also discussed by NATO researchers).⁷³ Researchers Lin Lina and Song Yueming, affiliated with the PLA Information Engineering University [中国人民解放军信息工程大学], a research institution specializing in network warfare,⁷⁴ describe a future integrated satellite-terrestrial network in the context of air and naval operations.⁷⁵ This network would rely on 5G low Earth orbit (5G LEO) satellites⁷⁶ to provide an integrated network for land, sea, and air warfare, providing backhaul by connecting 5G cell sites to data centres. While there are technical challenges to realizing such deployment of 5G technology, PLA-linked researchers have described a vision for how information networks might be adapted to future warfighting.

As seen in the bottom left of Figure 1, the military command uses the 5G base stations for efficient data transfer. Researchers envision '5G macro base stations inside large naval combat ships, which integrate and connect various types of fighters, sensors, and various support resources, equipment, and systems on the ship'. Additionally, researchers describe 5G nodes on long-endurance surveillance aircraft as allowing for the real-time incorporation of reconnaissance, which can act as a force multiplier for the naval fleet and attack aircraft. Finally, terrestrial forces can also access real-time tactical information through satellite communications. The implications of such technologies are manifold; more reliable communications at sea might allow forward-deployed command posts greater operational agility. This could have implications for China's amphibious assault capabilities. Similarly, research from the NATO Communications and Information Agency (NCI Agency) has discussed the implementation of 5G for amphibious communications, where shipborne 5G cells

⁷¹ Bi Xing [毕兴] et al., '5G is coming?'

⁷² Xinhua News Agency [新华社], 'See the First Informatization Unit of the PLA' [探访中国陆军第一支信息化部队].

⁷³ See Germano Capela et al., '5G for Deployable and Maritime Communications', *2021 International Conference on Military Communication and Information Systems (ICMCIS)*, 2021, <https://ieeexplore.ieee.org/document/9486397>.

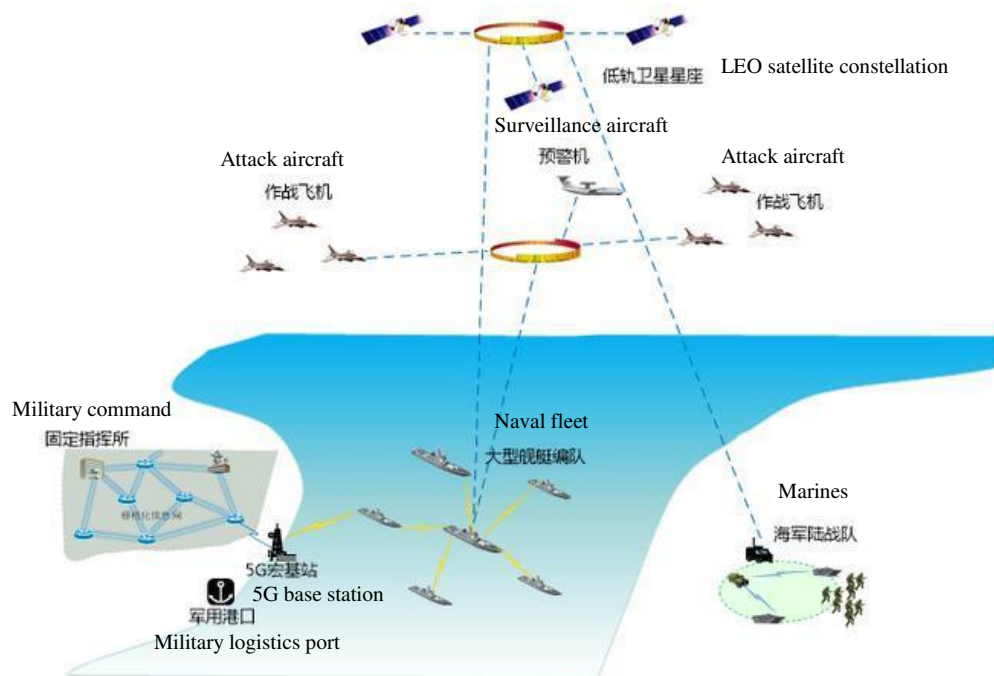
⁷⁴ Australian Strategic Policy Institute, China Defense Universities Tracker, 'Information Engineering University', <https://unitracker.aspi.org.au/universities/information-engineering-university-2/>.

⁷⁵ Lin Lina and Song Yueming, 'Naval Military 5G Application Research'.

⁷⁶ Small satellites that orbit approximately 500 and 2,000 kilometres above Earth's surface.

provide 'reach-back' connectivity to mobile amphibious units.⁷⁷ Enhanced data transmission rates could provide increased situational awareness for amphibious operations, which might be advantageous in a potential conflict over Taiwan.

Figure 1: Diagram of a Future 5G LEO Network⁷⁸



3.2 Unmanned Autonomous Systems and Unmanned Aerial Vehicles

Another potential deployment scenario for 5G networks is to improve the capabilities of unmanned aerial vehicles (UAV) and other cyber-physical systems, as well as those of unmanned autonomous systems (UAS). According to a 2019 article in China's *National Defence News*, 'one of the most important scenarios for the application of 5G technology is the precise control of unmanned systems'.⁷⁹ With ultra-reliable low-latency communications, 5G networks can theoretically enable precise and effective control of swarming UAVs (referred to in the article as a 'swarm of bees' [蜂群]). In a patent application, researchers affiliated with the PLA's Rocket Force Engineering

⁷⁷ Luis Bastos et al., 'Potential of 5G Technologies for Military Application', *2021 International Conference on Military Communication and Information Systems (ICMCIS)* (2021): 6.

⁷⁸ Lin Lina and Song Yueming, 'Naval Military 5G Application Research'.

⁷⁹ China National Defense News [中国国防报], '5G Technology Empowers Future Operations' [5G 技术赋能未来作战], 10 December 2019, <https://archive.ph/Khzwc>.

University [中国人民解放军火箭军工程大学] write that ‘network connection speeds in the 5G and 6G era and the leap in the development of AI technology continuously accelerate the development of machine intelligence and swarm optimization’.⁸⁰ In a related patent application filed by researchers at the Guangdong University of Technology, 4G is understood as limited in its capabilities for precise positioning, with current UASs relying on short-range communications technology with poor data transmission and latency. Using 5G-enabled real-time kinematics, researchers explain that ‘the 5G gateway provides stable and high-precision positioning information’.⁸¹ Precision positioning is likely a promising area for future 5G military research; outside of China, technical research has also been conducted on 5G positioning by firms like Ericsson.⁸²

Chinese national plans view 5G as an enabler for AI and autonomy. For example, the State Council’s ‘Next-Generation Artificial Intelligence Development Plan’ instructs the acceleration of the ‘application of 5G-enhanced technologies for the deployment of real-time collaborative artificial intelligence’.⁸³ 5G technologies could enable AI and autonomous applications in several ways.⁸⁴ For instance, UASs integrated with multi-access edge computing (MEC) systems could allow for faster communication and greater computational capabilities.⁸⁵ Similarly, 5G could enable improved situational awareness and provide additional security.⁸⁶

3.3 Logistics and Force Reinforcement

Experts in NATO member states have discussed how private 5G networks in smart ports present opportunities as well as security risks for military movement.⁸⁷ Chinese

⁸⁰ PLA Rocket Force Engineering University, CN114567401A, ‘Unmanned Aerial Vehicle Swarm State Joint Estimation Method Based on Perception and Communication Integration’ [一种基于感知通信一体化的无人机蜂群状态联合估计方法], filed on 14 April 2022, <https://patentimages.storage.googleapis.com/bd/96/8f/8e81fccf193579/CN114567401A.pdf>.

⁸¹ ‘Unmanned Aerial Vehicle and Unmanned Vehicle Cooperation Method Based on 5G Gateway’ [一种基于 5G 网关的无人机与无人车协作方法], 24 January 2022, <https://patents.google.com/patent/CN113238577B/en?qg=CN113238577B>.

⁸² Satyam Dwivedi et al., ‘5G Positioning: What You Need to Know’, Ericsson Blog, 18 December 2020, <https://www.ericsson.com/en/blog/2020/12/5g-positioning--what-you-need-to-know>.

⁸³ State Council of the People’s Republic of China, ‘Next Generation Artificial Intelligence Development Plan’ [新一代人工智能发展规划], 20 July 2017, <https://archive.ph/r1Exq>.

⁸⁴ NATO Strategic Communications Centre of Excellence, ‘When 5G Meets AI: Next Generation of Communication and Information Sharing’, February 2022, <https://stratcomcoe.org/publications/when-5g-meets-ai-next-generation-of-communication-and-information-sharing/237>.

⁸⁵ Congressional Research Service, ‘National Security Implications of Fifth Generation (5G) Mobile Technologies’, 4 June 2021, <https://fas.org/sgp/crs/natsec/IF11251.pdf>.

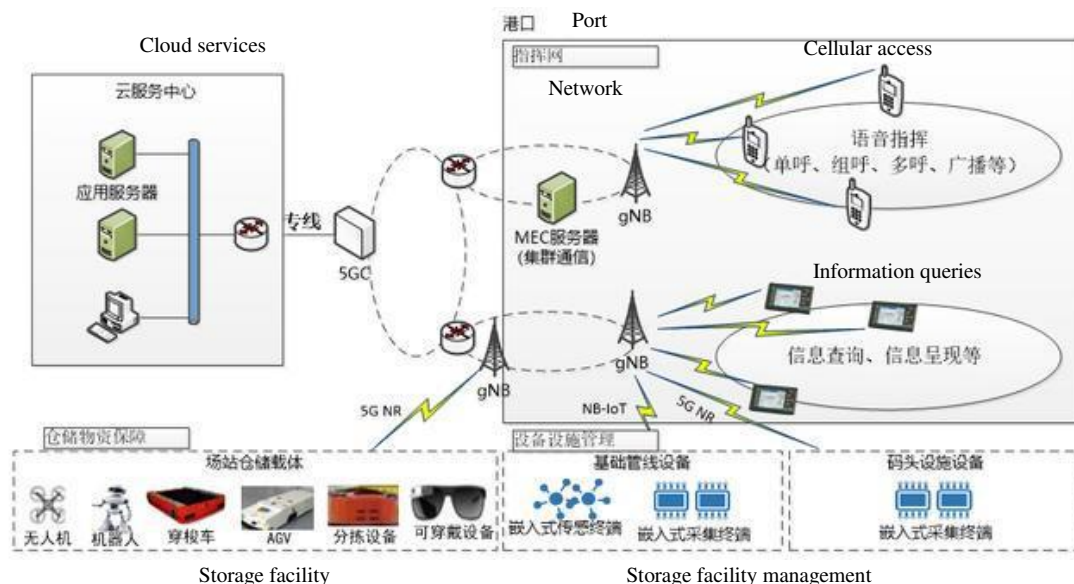
⁸⁶ Elsa B. Kania, ‘Why China’s Military Wants to Beat the US to a Next-Gen Cell Network’; Ministry of Foreign Affairs of the People’s Republic of China, ‘Foreign Ministry Spokesperson Hua Chunying’s Regular Press Conference’.

⁸⁷ Veeli Oeselt et al., *Military Movement: Risks from 5G Networks* (Tallinn: NATO CCDCOE, 2022).

scholars also recognize 5G as enabling military logistics and contributing to the modernization of logistical support. For example, researchers affiliated with the PLA's Academy of Military Sciences write that 5G 'will play a key supporting role in the construction of intelligent logistics for our military'.⁸⁸ In a potential future conflict, massive supplies will need to be moved. A smart port might use a private 5G network to efficiently handle military goods, providing real-time sensors and tracking for just-in-time operations. China has planned to invest in the broader 5G 'ecosystem' of industry verticals, which includes smart ports, smart warehouses, and intelligent transportation systems.⁸⁹ In 2021, China's Ministry of Information and Technology funded over 140 pilots of 5G technologies to improve public and commercial infrastructure.⁹⁰

Chinese sources have also introduced the concept of an 'intelligent' reinforcement and logistical support network.⁹¹ This encompasses efforts to improve procurement and supply efficiency, such as using 5G networking technology to make ports more efficient with real-time sensors, ship-to-shore communication, and autonomous operations. Figure 2 provides a diagram of a 5G-enabled port.

Figure 2: Diagram of a 5G Smart Port⁹²



⁸⁸ Li Feng [李峰] et al., *Analysis on the Application of 5G Technology in Modern Military Logistics* [浅析 5G 技术在现代军事物流中的应用], 2020.

⁸⁹ Rogier Creemers et al., 'Translation: 14th Five-Year Plan'.

⁹⁰ General Office of the Ministry of Industry and Information Technology [工业和信息化部办公厅], 'Notice of the General Office of the Ministry of Industry and Information Technology on Announcement of the List of Industrial Internet Pilot Demonstration Projects in 2021' [工业和信息化部办公厅关于公布 2021 年工业互联网试点示范项目名单的通知], 8 February 2022, <https://archive.ph/yY1Ug>.

⁹¹ Chinese authors typically use the word 'mobilization' to refer to logistics support and force reinforcement. Chongqing Civil Air Defense Office [重庆市人民防空办公室], 'Accelerate the Intelligent Construction of National Defence Mobilization' [加快国防动员智能化建设], 1 April 2020, <https://archive.ph/RhXLF>.

⁹² Lin Lina and Song Yueying, 'Naval Military 5G Application Research'.

4. China's Deployment of 5G Networks for National Security

Purposes

While the Chinese government has not yet implemented military 5G, it has begun to deploy 5G in contexts related to ensuring national security. In a recent statement, Xiu Changzhi, member of the National People's Congress and political commissioner of the Zhejiang Military Region, claimed that 'the Zhejiang military will further integrate its strength and resources, increase investment in the construction of "smart coastal defence", and use new technologies such as 5G'.⁹³ While statements from high-ranking officials on military 5G are rare, efforts to systematize technologies like 5G for national security purposes have taken form in infrastructure projects, emergency response, and research and development. While the previous section provided an overview of the theoretical deployment of military 5G networks and related applications, this section looks at actual dual-use 5G deployments in China.

4.1 5G Networks for Internal Security

The Chinese government has developed sophisticated domestic surveillance capabilities, collecting data from video and audio sources, as well as DNA and biometric information (e.g., iris scans).⁹⁴ Given the greater data transmission capabilities of 5G networks, they can enhance China's expansive data-gathering capabilities.⁹⁵ Some evidence has already linked companies like Huawei to China's domestic surveillance infrastructure.⁹⁶

The PLA has also recently constructed a radar outpost equipped with a 5G base station near the China-India border, which could be used for border-area communication and

⁹³ Xinhua News Agency [新华社], 'Implementing the Strategy of Governing the Army According to Law and Building a World-Class Army' [贯彻依法治军战略 建设世界一流军队——习近平主席在解放军和武警部队代表团发表的重要讲话引起强烈反响], 2022, <https://archive.ph/11rB9>.

⁹⁴ 'Four Takeaways From a Times Investigation Into China's Expanding Surveillance State', *New York Times*, 21 June 2022, <https://www.nytimes.com/2022/06/21/world/asia/china-surveillance-investigation.html>.

⁹⁵ Gulchehra Hoja, 'China's Rollout of 5G Base Stations in Xinjiang Will Boost Surveillance, Experts Say', *Radio Free Asia*, 14 October 2022, <https://www.rfa.org/english/news/uyghur/xinjiang-5g-10142022163853.html>.

⁹⁶ Eva Dou, 'Documents Link Huawei to China's Surveillance Programs', *Washington Post*, 14 December 2021, <https://www.washingtonpost.com/world/2021/12/14/huawei-surveillance-china/>.

force mobilization.⁹⁷ According to Indian military officials, this installation was part of China's broader attempt to build up infrastructure along the Line of Actual Control (LAC) between the two countries. 5G networks along the border would provide the PLA with the ability to improve the mobilization of military forces through stable communications.⁹⁸ Analysts have also suggested that 5G networks could enhance China's border surveillance capacities.⁹⁹ Yet, China's official statements about this infrastructure note the benefits for improving personal communications, bridging 'the communication gap between soldiers and their families and friends'.¹⁰⁰

4.2 5G Networks for Mission-Critical Communications

China has also shown interest in deploying 5G mission-critical communications for public safety organizations. Recently, Jilin Province conducted a 'national defence mobilization'¹⁰¹ drill and used 5G networks to support emergency communications.¹⁰² In Chengdu, military bases employed 5G for natural-disaster response drills, setting up a 'UAV 5G emergency communication network'.¹⁰³ While this drill was ostensibly for the purposes of disaster response, it was also described as a way to 'improve the level of national defence mobilization'. In another drill, local PLA-affiliated militias used a 5G command and control system to direct participants in a 'military day' exercise.¹⁰⁴ Such drills, of course, do not show that the PLA has already deployed military 5G networks, but they do indicate plans to do so in the near future. The United States and other NATO members have also piloted private 5G networks for mission-critical networks.¹⁰⁵

⁹⁷ Tenzin Dalha, '5G and the Contested China-India Border', *Diplomat*, 11 June 2021, <https://thediplomat.com/2021/06/5g-and-the-contested-china-india-border/>.

⁹⁸ Prabin Kalita, 'China Constantly Building LAC Infra: Army Commander', *Times of India*, 17 May 2022, <https://timesofindia.indiatimes.com/india/china-constantly-building-lac-infra-army-commander/articleshow/91604911.cms>.

¹⁰⁰ '5G Coverage, Road Clearing, Multi-energy Power Supply, and Grassroots Construction Warm Border Defense Officers and Soldiers' [5G 覆盖、抢通道路、多能供电，基层建设情暖边防官兵], *PLA Daily* [解放军报], 10 November 2021, <https://archive.ph/eqwKK>.

¹⁰¹ Readiness drills at the provincial level are typically less organized than formal PLA military exercises.

¹⁰² Jilin Provincial Communications Administration [吉林省通信管理局], 'Jilin Provincial Communications Administration Launched the Province's Emergency Communications and National Defense Mobilization Emergency Communications Drill' [吉林省通信管理局开展全省应急通信暨国防动员应急通信演练], 11 June 2016, <https://archive.ph/GB9wz>.

¹⁰³ 'Technology Empowered! Chengdu Military Bases Carry Out Comprehensive Drills to Deal with Rainstorms, Floods and Geological Disasters' [科技赋能！成都市军地开展应对暴雨洪涝与地质灾害综合演练], *PLA Daily* [解放军报], 12 May 2022, <https://archive.ph/dQP48>.

¹⁰⁴ 'Zhoukou City Holds "Military Day" Activities in 2021' [周口市举行 2021 年“军事日”活动], *Zhoukou Daily* [周口日报], 11 October 2021, <https://archive.ph/lyZKk>.

¹⁰⁵ United States Department of Defense, 'DOD Begins Fielding 5G Communications to California First Responders', 21 October 2021, <https://www.defense.gov/News/News-Stories/Article/Article/2818134/dod-begins-fielding-5g-communications-to-california-first-responders/>.

4.3 Maritime Communications

Chinese telecommunications firms, such as China Mobile, have started to develop 5G for maritime communications, including networks on ships.¹⁰⁶ In one example, Chinese technology firms have installed coastal 5G base stations in the 700Mhz radio frequency band capable of extending coverage over 75 km into the waters off China's coast.¹⁰⁷ While actual deployments of 5G remain limited, recent partnerships between civilian firms and the PLA could lead to future applications. As an example, China Mobile Zhejiang Company (a subsidiary of China Mobile) also recently entered into a strategic cooperation agreement with the PLA Eastern Theatre Naval Staff Department (Eastern Sea Fleet) to integrate and promote innovation in 5G.¹⁰⁸ The press release for this partnership mentions several applications, including intelligence gathering and information sharing, 5G BeiDou (China's global navigation positioning system) integrated positioning, 5G emergency communications, and 5G video command.¹⁰⁹ Efforts to integrate 5G technologies within the maritime domain are likely meant to support President Xi's ambitions for China to become a 'maritime great power' [海洋强国] as part of the broader goals to create a 'world-class military' [世界一流军队].¹¹⁰ In light of these developments, and given that NATO researchers consider maritime 5G communications one of the near-term use cases, China's 5G-enabled maritime capabilities are especially worth tracking for the NATO defence community.

¹⁰⁶ 'Enabling 5G at Sea, ZTE Joins Hands with China Mobile to Promote High-Quality Marine Economic Development', Mobile World Live, 20 April 2022, <https://www.mobileworldlive.com/zte-updates-2019-20/enabling-5g-at-sea-zte-joins-hands-with-china-mobile-to-promote-high-quality-marine-economic-development>.

¹⁰⁷ 'Weihai Mobile: Improve the "Maritime 5G Network" and Implement the Strategy of Ocean Power' [威海移动：完善“海上5G网络” 落实海洋强国战略], QQ News, 2022, <https://new.qq.com/omn/20220227/20220227A0397100.html>.

¹⁰⁸ 'Zhejiang Mobile and the Naval Staff Department of the Eastern Theater Command Work Together'.

¹⁰⁹ See 'Zhejiang Mobile and the Naval Staff Department of the Eastern Theater Command Work Together'.

¹¹⁰ Andrew Chubb, 'Xi Jinping and China's Maritime Policy', Brookings Institution, 22 January 2019, <https://www.brookings.edu/articles/xi-jinping-and-chinas-maritime-policy/>.

5. China's Approach to Dual-Use 5G Technology

Even though dual-use (both military and civilian) 5G technology represents only a minuscule fraction of China's total national investment in 5G of \$400 billion, it would still represent a significant amount, given the sheer size of China's 5G technology market. For military communications, Chinese market analysts put the total amount of spending at approximately \$4 billion in 2020, with an estimated market size of over \$7 billion by 2025.¹¹¹ The PLA has not focused its efforts on procuring 5G technology as it has for AI and autonomous systems.¹¹² Instead, much of the innovation in military 5G networks has currently taken place at PLA-linked research institutions and private defence companies.

5.1 PLA's Role in Innovation

Information about the PLA's current research and development programmes is not generally publicly accessible. However, one way of assessing the PLA's 5G efforts is through patent applications for 5G-related dual-use technologies filed with the Chinese Patent Office. While patent records do not represent a complete overview of military or dual-use applications related to 5G networks in China, they provide some indication of the PLA's interest in exploring dual-use applications for 5G networks.¹¹³ Many patents are filed by institutions linked with the PLA, including the engineering components of the PLA and affiliated institutions like China's Academy of Military Sciences. The PLA's signals and communications research institutions have submitted patents on basic network architecture topics such as network slicing for 5G.¹¹⁴ However, PLA research institutions have also filed patent applications that are more relevant to 5G military or dual-use applications. In one patent, the PLA Rocket Force University describes a communications network that uses 5G mobile base stations to

¹¹¹ Huatai Securities [华泰证券], 'In-Depth Study of Military Communication Industry: Advanced Infrastructure for National Defense Informatization' [军事通信行业深度研究：国防信息化先行基础设施], January 2022, <https://archive.ph/Bu4yF>.

¹¹² Ryan Fedasiuk, Jennifer Melot, and Ben Murphy, 'Harnessing Lightning: How the Chinese Military Is Adopting Artificial Intelligence', Center for Security and Emerging Technology, October 2021, <https://cset.georgetown.edu/publication/harnessed-lightning/>.

¹¹³ The patent data is gathered from Google Patents, see <https://patents.google.com/>. The search terms include a combination of '5G', '5G network' [5g 网络], '5G base station' [5G 基站], 'PLA' [人民解放军], and 'drone' [无人机].

¹¹⁴ Information Engineering University of the PLA Strategic Support Force, 'A Kind of 5G Network Slice Example Dynamic Switching Method and Function' [一种 5G 网络切片实例动态切换方法和功能], filed on 22 January 2019, <https://patents.google.com/patent/CN109951440A>. See also, <https://patents.google.com/patent/CN112217861A>.

enable a ‘military internet of things’.¹¹⁵ Other patent applications by the PLA Rocket Force University focus on the technical challenges of drone swarming technology, mentioning that 5G technology has accelerated ‘machine intellectualization and swarm optimization’.¹¹⁶ The PLA’s Academy of Military Sciences has also submitted patent applications for drone technology, such as a relatively simplistic technical model for ‘5G Communication Equipment for an Unmanned Aerial Vehicle’.¹¹⁷ So far, these applications indicate that PLA-linked institutions are interested in 5G-related research and development for dual-use applications but do not indicate whether the PLA will develop possible use cases in the near future. Indeed, experts have argued that China’s patent filings on AI are high in quantity but not quality, and the same trend may be true for 5G-related dual-use applications.¹¹⁸ Still, it is evident from the patent records that interest in 5G military applications is growing in China.

5.2 Industry’s Role in Innovation

China’s defence industry, under the purview of MCF, has recently invested in the development of 5G technology, including hardware.¹¹⁹ In just one example, Tian He Defence [天和防务] invested over three billion yuan (\$300 million) in a so-called 5G communication industrial park [5G 通讯产业园] comprising data centres, research labs, and factories.¹²⁰ Since 2018, some of China’s most prominent telecommunication companies have joined the 5G Technology Military-Civil Fusion Applications Industry Alliance [5G 技术军民融合应用产业联盟], with participants including ZTE, China Unicom, and the China Aerospace Science and Industry Corporation (CASIC).¹²¹ Some private companies conducting research and development for military

¹¹⁵ PLA Rocket Force University of Engineering, CN217467691U, ‘A Two-Level Maintenance Support System for Military Internet of Things’ [一种面向军用物联网的两级维修保障系统], filed on 7 January 2022, <https://patents.google.com/patent/CN217467691U>.

¹¹⁶ PLA Rocket Force Engineering University, CN114567401A, ‘Unmanned Aerial Vehicle Swarm State Joint Estimation Method’.

¹¹⁷ PLA Academy of Military Sciences, CN212605797U, ‘5G Communication Equipment for an Unmanned Aerial Vehicle’ [一种基于无人机用 5G 通信设备], filed on 7 August 2020, <https://patents.google.com/patent/CN212605797U>.

¹¹⁸ Jeff Ding, ‘China’s Current Capabilities, Policies, and Industrial Ecosystem in AI’, Testimony before the U.S.-China Economic and Security Review Commission Hearing on Technology, Trade, and Military-Civil Fusion: China’s Pursuit of Artificial Intelligence, New Materials, and New Energy, 7 June 2019.

¹¹⁹ See, for example, Xi’an Tian He Defense Technology Co. [西安天和防务], <http://www.thtw.com.cn/>.

¹²⁰ ‘Tianhe Defense: Plans to Invest in the Construction of a 5G Communication Industrial Park Project’ [天和防务：拟投建 5G 通讯产业园项目], *Sina Finance*, 29 August 2022, <https://archive.ph/NJSAZ>.

¹²¹ Hu Wei [胡巍], ‘5G Technology Military-Civil Integration Application Industry Alliance Established in Beijing’ [5G 技术军民融合应用产业联盟在北京成立], 5 November 2018, <https://archive.ph/c0KcR>.

communications, such as Chongqing Jinmei [重庆金美], previously existed as state-run entities, which suggests that close collaboration with state entities might continue.¹²² Other private companies, like Guorui Defence [国睿防务]¹²³ and Tian He Defence, are defence contractors of the PLA. And finally, some companies, such as Inspur, a cloud services provider and one of China's largest technology companies, run diversified technology services and may have nascent investments in dual-use applications of 5G.¹²⁴

¹²² Chongqing Jinmei Communication Co. [重庆金美通信有限责任公司信息技术分公司], <https://www.qcc.com/firm/edec657602887bfa924ef7c6f35614ae.html>.

¹²³ 'Guorui Technology (600562): A Force in Military Electronics, Defence Radar, Industrial Software' [国睿科技 (600562): 军工电子主力军 防务雷达+工业软件双轮驱动], *Sina Finance*, <https://archive.ph/RryiG>.

¹²⁴ See Inspur, <http://inspur.cn/>.

6. Conclusion

This article has provided a brief overview of China's thinking, plans, and activities in leveraging 5G networks for military purposes and developing associated military applications. The publicly available sources reviewed in this article indicate China's intent to capture the strategic value of 5G for the military context. While China does not have a standalone military 5G strategy as some NATO member states do, PLA officials and military research institutions have been engaged in conceptual research on the role of 5G in future warfighting. Research institutions and private companies have also filed patents and developed dual-use applications for 5G networks which could be used for military and national security purposes.

Future research should continue to assess the challenges and opportunities of military and dual-use applications for 5G networks, monitor China's plans and activities in these areas, and recommend ways and means to maintain NATO's edge.