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Security Challenges

Development of the Chinese A2/AD System in the Context of US–China Relations

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Abstract—In recent years, the growing arms race between the United States and China has begun to affect almost all areas of the offensive and defensive military potential of the two countries. One of its key directions is the development of the Chinese anti-access/area denial (A2/AD) system, aimed at blocking enemy's military actions, information tools, and capabilities in various zones of the theater of operations, as well as the US response to counter this strategy. The Chinese A2/AD concept and its correlation with the doctrine of development of the Chinese Armed Forces are analyzed. Additionally, based on systematic analysis and analysis of sources and statistical data, the dynamics of strengthening the main elements of China's A2/AD system over the past decade is discussed, including high-precision missiles, ground and air defense systems, fourth-generation tactical aircraft, electronic warfare, antisatellite weapons, and cyberwarfare. Several conclusions are made as to the effect of these processes on the US doctrines and principles of deploying forces in the Asia–Pacific region.

Keywords: United States, China, anti-access/area denial, missiles, air defense, tactical aviation, cyberoperations, electronic warfare

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The growing contradictions between China and the United States over the past few decades have increasingly manifested themselves in their policies regarding the development of modern weapons and in the doctrines of the use of armed forces. The growing arms race in recent years has affected almost all the areas of development of the offensive and defensive military potential of the two countries, including their strategic nuclear forces and conventional forces. It can be traced in the race of high-precision weapons, land and sea-based air defense an missile defense systems, space warfare, and hypersonic weapon systems. These processes have especially escalated in the past few years, when the period of confrontation between Washington and Beijing in the military–political sphere, along with the development of cooperation in other areas (primarily in bilateral trade), gave way to the large-scale aggravation of bilateral relations against the backdrop of a tougher, in the opinion of the United States, course by China in the Asia–Pacific region (APR) and adjacent seas, strengthening Chinese strategic forces and capabilities of intelligence and surveillance systems, and developing a wide range of military technologies in China.[1] At the same time, the doctrines of the use of relevant weapons are being reviewed in the same direction, including the concepts of nuclear and conventional deterrence, force projection, network-centric warfare, and information warfare [Kashin and Lukin, 2021; Kamennov, 2019; *Military and Security Developments...,* 2021; Montgomery, 2014].

This paper examines the development in the PRC in the last decade of the systems of anti-access/area denial (A2/AD systems), which are important for strengthening the conventional forces and means of the armed forces, as well as for combat operations in order to block the actions of the enemy from the point of view of its offensive opportunities and information means of their provision. The corresponding Chinese Anti-Access/Area Denial (A2/AD) strategy was developed just over a decade ago as an answer to the question of how China could counteract the likely military scenarios of US actions (including interservice operation) in the event of interference by US forces or their allies in possible conflicts involving the PRC, and with

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[1] Since 2017, the US National Security Strategy, the National Defense Strategy, and other US strategic documents have begun to note the growing trend of military confrontation between the leading powers. The most likely opponents of the United States are named Russia and China.

the help of which military means the PRC can control strategically important maritime zones in case of a military escalation. At the same time, this strategy (its other common name is the "counterintervention" strategy) took into account that the United States has superiority over China in aviation; warships and naval weapon systems; command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems; and other combat and information assets in these zones.

Various aspects of the A2/AD concept have been widely studied in recent years by foreign (primarily Chinese and American) and Russian experts. The problems of the US response to the formation in China of a system of anti-access/area denial and other related programs of the PRC's military development were considered by M. Kofman, E. Montgomery, D. Ochmanek, L. Jinghua, and other authors [Kofman, 2019; Montgomery, 2014; Ochmanek, 2014; Jinghua, 2019]. There were also discussions on the possible consequences of the US–China conflict in the Western Pacific with the use of A2/AD systems on both sides [Gompert, et al., 2016]. A number of studies compared the Russian and Chinese approaches to the development of A2/AD assets and also analyzed the American concept of an AirSea Battle, which became one of the responses to strengthening China's counterintervention capabilities [Kofman, 2020; Kazianis, 2014]. Many Russian researchers have also paid attention to this issue, including in the context of the development of the PRC's strategic and nonstrategic forces [Arbatov, 2022; Bogdanov and Yevtodyeva, 2021; Kamennov, 2019; Kashin, 2016].

The main objective of this paper is to analyze the course and pace of the formation of the A2/AD system in the PRC over the past decade and to assess the consequences that these processes may have for the military and military–political strategy of the United States in the Asia–Pacific region.

FORMATION OF THE CHINESE A2/AD CONCEPT

According to an approach shared by many military experts, the core elements of an effective A2/AD system or specific weapons that provide a "counterintervention strategy" include accurate ballistic and cruise missiles; integrated multilayer surface-to-air defenses; large numbers of fourth generation fighter aircraft and high-yield air-to-air missiles; near real time distributed surveilance and reconnaisance systems, and command and control networks; electronic warfare systems (jamming); antisatellite weapons; and cyber weapons [Ochmanek, 2014]. Taken together and considering the relatively recently developed modern concepts of combat operations (the American concept of a multidomain operation and an interbranch AirSea Battle or the concept of joint information operations in the PRC) [Bogdanov and Yevtodyeva, 2021], A2/AD tools allow solving a wide range of operational tasks. First of all, we are talking about strengthening the interaction between the branches of the armed forces within the framework of the operation; increasing the combat stability and survivability of interbranch forces and assets, including through their distributed formation; development of combat information networks (including interbranch ones), integrating reconnaissance and strike capabilities in the theater of operation; increasing the effectiveness of the use of high-precision weapons as the main combat means; etc. Combined within a specific operation, all these assets—from guided missiles to submarines and cyberweapons—serve the chief goal: blocking enemy access and actions in certain areas of the battlefield [LaGron, 2015].

The Chinese concept of A2/AD was developed in the 2000s; moreover, in the same period, the People's Liberation Army of China (PLA) abandoned the doctrine of "people's war," aimed at a massive build-up of conventional forces, and switched to the doctrine of information (or informatized) war aimed at strengthening high-tech combat forces while relying on A2/AD means. In response to the PRC's efforts to increase anti-access/area denial capabilities against the US Air Force and Navy, the United States introduced the AirSea Battle concept in 2010, an operational concept that gives the US forces opportunities to counter an adversary in a nonpermissive strategic environment. In the context of countering China, it, along with an appropriate set of military tools, aims to "open access" to a potential battlefield through a blinding campaign against PLA networks using attacks on China's command, control, computer, communications, intelligence, surveillance, and reconnaissance (C4ISR) systems and its strike systems (including missile launchers), as well as to seize and sustain the initiative in the air, sea, space, and cyber domains [*SIPRI Yearbook*, 2015, pp. 272, 273; Cavas, 2013].

Since the development of the Chinese A2/AD doctrine and the American concept of AirSea Battle, both the United States and China have significantly strengthened their air and naval forces in the APR—along with their capabilities in the field of missile, cyber, and electronic weapons and antisatellite systems. Until the early 2010s, the PRC had at its disposal only some components of the A2/AD system. However, from the time the relevant doctrine was put forward until the current stage, China's potential in the A2/AD area has been developing so actively that Western analysts are increasingly expressing concerns about the consequences of these processes in the APR [Montgomery, 2014; Ochmanek, 2014].

BUILDING UP A2/AD IN THE PRC

In determining which specific means belong to the A2/AD potential, it is necessary, first, to emphasize the difference between the A2/AD and C4ISR systems

of modern armies. The C4ISR systems include all the means of collecting information (including intelligence), command, control, and communications through a constellation of satellites and ground infrastructure. In addition to the radar and data transmission systems of fighter aircraft and warships, they also include reconnaissance drones, early warning aircraft (AEW), and several other systems. Accordingly, we are talking about a complex of information support for own armed forces. A2/AD is an information and strike potential configured to defend against enemy intrusions and disrupt enemy's information systems, as well as provide subsequent target designation for own forces based on the data received. Based on this logic, A2/AD does not include nuclear-armed systems because they cannot be used for counterintervention purposes. In other words, the A2/AD concept itself provides for the development of countermeasures, in fact, only against an attack using conventional weapons, while the capabilities of nuclear forces and the concept of nuclear deterrence should be considered as a separate part of the armed forces and military strategy.

If we talk about China's missile potential, i.e., development and adoption of high-precision ballistic and cruise missiles, it has been rapidly strengthening in the last decade in both nuclear and nonnuclear equipment. In the field of ballistic missiles, it consists of the Dongfeng-5/5A/5B and Dongfeng-31/31A/31AG ICBMs, and the Dongfeng-41, which is only just being introduced into the combat structure of the PRC Rocket Force,[2] as well as intermediate-range ballistic missiles (IRBMs) Dongfeng-21, Dongfeng-26, Dongfeng-15, Dongfeng-16, and Dongfeng-17. In the context of A2/AD, one should not consider only nuclear ICBMs and IRBMs that cannot be equipped with conventional warheads (Dongfeng-5, Dongfeng-31, and Dongfeng-41 ICBMs, as well as Dongfeng-21A/B IRMs). Nevertheless, China has a lot of nonnuclear missile weapons "on the balance sheet." Among intermediate-range ballistic missiles, there are five types of missiles (Dongfeng-21C/D, Dongfeng-26, Dongfeng-15, Dongfeng-16, and Dongfeng-17); among cruise missiles, missiles of two types: Donghai-10A (CJ-10) and Donghai-20 (CJ-20). The A2/AD potential also includes a number of anti-ship missiles that are in service in the Chinese Navy, including the S-802, KD-88 (cruise anti-ship missile), and some others. This should also include air-to-air and air-to-surface missiles of relatively long range and power, with which modern Chinese fighters, such as the Su-27, Su-30, Su-35, J-15, J-16, J- 17, and J-20, are equipped: P-27, X-29, X-31, PL-15, PL-21, YJ-83, and others.

Intermediate-range missiles Dongfeng-21 (with a range up to 4000 km) and Dongfeng-26 (3000–5500 km), which have been in service since the late 1990s, can be equipped with both nuclear and conventional warheads[3] and have maneuvering reentry vehicles with improved performance in terms of range, payload, and speed, making them the most modern types of missiles of this class [Ukhov, 2019]. Dongfeng-26 (the so-called "Guam killer") can hit Guam, where the largest US strategic military base in the Pacific Ocean is located, from a distance of 4000 km. The Dongfeng-21D with a terminal radar-guidance system, or, as American sources describe it, the "aircraft carrier killer," is today considered the only anti-ship ballistic missile in the world. According to some estimates, it may pose a significant threat to US aircraft carrier groups in the Pacific.[4] The new Dongfeng-17 IRBMs, which have recently entered service, will also be dual-use systems and can be equipped with a hypersonic glide vehicle, capable of overcoming any missile defense.

If in terms of the total ammunition of the PRC Rocket Force, which includes nuclear-armed ICBMs and IRBMs, expert estimates differ little [Yesin, 2020; *Military Balance*, 2021, p. 230],[5] it is rather difficult to estimate the total number of deployed Chinese missile systems related to A2/AD. One can only assume that, considering the very wide list of types of corresponding missiles, it is at least several times greater than the number of nuclear-tipped systems.

Tactical aviation of the PRC is actively developing, and in the last 10–20 years, an advantage has arisen due to entering into service of fourth-generation and 4+-generation aircraft, including Su-35 fighters. The fleet of fighter aircraft includes the Su-27SK, Su-30MKK, Su-30MK2, and Su-35 delivered from Russia, as well as their Chinese-made "analogues" J-10A/B/C/S, J-11B/BS, J-15, J-16, and J-20A. According to *Military Balance 2021*, as of the end of 2020, there were 886 aircraft of these types in the PRC Air Force, and 153 aircraft in naval aviation. In addition, the PRC Air Force and Naval Aviation have

[2] Dongfeng-5B, Dongfeng-31AG, and Dongfeng-41, the latest most advanced missiles in their lineup, have a range of 11000–14000 km and are equipped with means to overcome missile defense and with several multiple independently targetable reentry vehicles (MIRVs) [Yesin, 2020].

[3] Dongfeng-21 in a conventional capable variants are represented by Dongfeng-21C and Dongfeng-21D.

[4] Since the beginning of its deployment, the Chinese leadership has stated that the Dongfeng-21D can hit large moving surface ships, including aircraft carriers. Several experts, having analyzed the capabilities of the Chinese intelligence, surveillance, and reconnaissance system, doubt that the Dongfeng-21D and Dongfeng-26B high-precision anti-ship ballistic missiles are currently capable of striking moving warships from a distance of several hundred kilometers [Watanabe, 2021].

[5] The total ammunition of the PRC Rocket Force could be about 340–350 missiles and 400–410 nuclear warheads. The number of ICBM launchers, according to the estimates of the US Department of Defense, reaches approximately 200, and the number of IRBMs in service is slightly less.

260 JH-7 and JH-7A fighter-bombers. The latter are equipped with Russian Kh-29L and Kh-29T air-to-surface guided missiles, as well as KAB-500kr guided aerial bombs and their analogues. Since 2002, new S-803K anti-ship cruise missiles have been put into service to equip JH-7A aircraft.

The latest Chinese fighter variants, such as the J-16, have improved performance and combat capabilities. In particular, the J-16 is equipped with an active phased array radar (AFAR), while the Chinese Su-35s are equipped with less powerful radars with a passive electronic scanning array. The development of the J-16D aircraft, designed for electronic warfare, is underway; it is currently undergoing flight tests [*Military Balance,* 2021, p. 232]. In addition, China, during special exercises, is exploring the possibilities of strengthening coordination between units of the Air Force, naval aviation, special units of antisubmarine warfare, etc. A significant number of such exercises are being conducted in the region around Taiwan.

It should be noted that, within the framework of the PLA, in parallel with the development of A2/AD, the potential of aviation and naval systems related to C4ISR is increasing significantly. Thus, in 2020, the PLA Air Force was armed with about two dozen or more AEW aircraft created on the basis of the Y-8 aircraft,[6] including 13–19 KJ-500s and 5 KJ-200s (Y-8Ws). In addition, four platforms were purchased from Russia for the most modern Chinese KJ-2000 AEW&C aircraft, developed in the 2000s on the basis of the Russian A-50 with Chinese radars, which replaced the Israeli radio-technical complex with an EL/M-205 radar with three AFARs (Israel's sale of such systems to China in 2000 was blocked under US pressure) [Linnik, 2017]. Electronic warfare (EW) aircraft were created by China also on the basis of the Y-8; in total there are up to ten aircraft of the Y-8CB/XZ type and four Y-9G. Up to 20 electronic reconnaissance aircraft are also in service, including Y-9 JZ/X/XZ, Y-8G, and the Soviet Tu-154. More than 40 special aircraft, including AEW and electronic reconnaissance aircraft, are in the PLA naval aviation [Khramchikhin, 2022].[7]

EW and AEW aircraft, including the KJ-2000, greatly facilitate the tasks of the Chinese Air Force and Navy in collecting real-time intelligence and border's surveilance.[8] They also allow PLA fighters to be less vulnerable to detection by providing them with situational awareness without using (i.e., turning on) their own radar systems.[9] The PRC also provides early warning capabilities through the supply of long-range and medium-range high-altitude unmanned aerial vehicles (UAVs), which are used primarily in maritime surveillance. There are currently more than ten types of UAVs in service with the PLA ground forces, naval aviation, and the Air Force, including the heavy Pterodactyl I, Wing Loong, BZK-005, and ASN-229A, as well as medium UAVs BZK-006, BZK-007, and BZK-008 [*Military Balance,* 2021, pp. 250–255].

As for air and missile defense, today the PRC has a fairly reliable multilayer air and missile defense system that covers the entire land territory of China and territory up to 550 km from its coast. It relies on a network of early warning radars, advanced fighter aircraft, and various antiaircraft missile systems (SAMs). An important part of it is Russian S-300PMU and S-300PMU1/PMU2 systems, purchased in the late 1990s–2000s, capable of tracking and hitting various types of targets, including tactical aircraft, as well as cruise and ballistic missiles, at ranges up to 200–250 km.[10] China has placed air defense system radars at key outposts in the South China Sea and on several types of destroyers, greatly increasing the range of integrated air defense. The capabilities of AEW aircraft also have the effect of expanding the coverage area of radars beyond the range of ground-based radars and SAMs. China also uses point defense, i.e., the same air defense systems to protect strategic facilities from long-range cruise missiles and enemy aircraft. At the same time, air defense systems that increase operational mobility are being strengthened, for example, the wheeled version of the HQ-17 HQ-17A SAM adopted for service [*Military Balance,* 2021, pp. 230, 251].

For comparison, it can be noted that at the end of 2010, according to the *Military Balance*, the basis of China's air defense system was just over 300 antiaircraft missile systems, including HQ-7, HQ-9, HQ-12, S-300, and S-300PMU1/PMU2. At the end of 2020, the PLA had already more than 850 antiaircraft missile systems, including about 550 long-range systems [*Military Balance*, 2011, p. 234; *Military Balance*, 2021, pp. 254, 255]. Basically, the buildup is due to the increase in the equipment of troops with Chinese air defense systems: long-range HQ-9 and HQ-9B systems, medium-range HQ-2 and HQ-12 systems, HQ-17/HQ-17A complexes, and HHQ-9 naval systems.

To improve the capabilities of its air defense in 2014–2015, China purchased from Russia 32 S-400 Triumph antiaircraft missile systems (several divisions), which made it possible to expand the range of

[6] An improved version of the Y-8 is the Y-9, which is considered a completely Chinese aircraft and is produced only in special versions.

[7] *Military Balance 2021* data indicates a slightly smaller number of AEW aircraft in service in the PLA Air Force: 19 AEW and 19 EW aircraft. In naval aviation, according to the publication, there are 24 AEW aircraft.

[8] In particular, the Y-8J is reportedly capable of detecting such small objects as a submarine periscope within a range of up to 185 km.

[9] Previously, this kind of capability provided the US Air Force with significant advantages in battles beyond the visual range. Now the United States actually has lost these advantages in the event of a potential conflict with China [Bilsborough, 2013].

[10] The maximum range of fire of the S-300PMU2 is indicated.

ground-based air defense up to the entire territory of Taiwan, as well as airspace over a significant part of the South China and East China Seas [Yevtodyeva, 2018].[11] An even more significant breakthrough for the PRC was coming to an argeement with Russia on assistance in the creation of a missile attack warning system [Valdai Discussion Club Meeting, 2019], which, apparently, provides for the construction in the PRC of over-horizon early warning radars modeled on Russian ground-based early warning radar stations of the Voronezh type. Previously, China did not have the appropriate technologies and capabilities in the field of early warning of a missile attack (covering the territory of the United States, Japan, and South Korea, from where missile strikes could potentially be launched).

In the past decade and a half, the PRC has achieved a number of significant successes in its space program, as well as in the development of anti-satellite systems. Thus, after a landmark test of anti-satellite weapons in 2007, while simultaneously strengthening the civilian component of the space program, China has demonstrated significant success in space programs related to C4ISR. The Beidou series of global positioning satellites (Beidou-2 and Beidou-3), a Chinese alternative to the GPS satellite system, achieved full regional coverage several years ago, and global coverage by 2020 [China to Complete..., 2019; Qian and Xiaotong, 2020]. China has been successful in modernizing and expanding its space launch infrastructure under the leadership of the PLA General Armaments Department. In general, the launch programs of the Yaogan and Shijian series of satellites, which are used in the target designation system for launching high-precision missiles and electronic intelligence satellites, are going well.

According to *Military Balance*, in 2020 China had 45 navigation and positioning satellites (15 Beidou-2 and 30 Beidou-3 of various modifications), about 30 military tactical reconnaissance satellites (designed to track moving targets in a mode close to real time), and 40 signal and electronic intelligence satellites (ELINT/SIGINT), including Yaogan-30/32, Shijian-6, and Shijian-11. It should be noted that, at the end of 2010, China had at its disposal only eight navigation and positioning satellites (Beidou-1 and Beidou-2), about 15 reconnaissance satellites, and eight satellites with ELINT/SIGINT functions [*Military Balance*, 2011, p. 480]. Thus, at that time, the total number of Chinese military satellites launched into orbit was not about 130–140 (as at the end of 2020) [Kamennov, 2019, p. 43; *Military Balance*, 2021, pp. 250–255] but only 31. Several satellite programs—Beidou, Yaogan, and others—were only at the initial stage. In total, according to available estimates, China currently has more than 350 satellites in orbit, while the United States has 1300, and Russia has 170 [Arbatov, 2022].

In 2007, China successfully tested its ground-based anti-satellite weapons by destroying an orbital target, the Fengyun meteorological satellite, with a medium-range ballistic missile. Since then, the PRC has continued to conduct other anti-satellite weapons tests [Weeden, 2020], as well as to develop anti-satellite systems and related technologies, including kinetic missiles, ground-based lasers, and orbital space robots. The capabilities for anti-satellite operations are also being worked out [*Military and Security Developments...*, 2019, p. 56].

Thanks to the growth in the capabilities of deployed space systems, including communications satellites and reconnaissance and surveillance satellites, the PRC was able to increase the role of command and control systems in joint operations. The PLA was also able to improve significantly the geolocation and precision strike capabilities, continuous global satellite surveillance, military communications and data transmission architecture. China's active improvement of C4ISR capabilities, as well as space and anti-satellite programs, could threaten the space assets deployed in this region, as well as the potential of the Air Force and Navy of the US and its allies. This trend is also reflected by the assessments of American experts, who show that by the mid-2010s China actually overtook Russia in the deployment of A2/AD systems, becoming the second power after the United States in terms of development of anti-access systems [Ochmanek, 2014, p. 2].

In addition to the development of the A2/AD components listed above, military analysts also see significant cyber and electronic warfare capabilities as key to an effective PRC "counterintervention strategy" that can effectively disrupt enemy's command and control systems and communications [*Military and Security Developments...,* 2021, pp. 77–79; Kashin, 2016].

As the advantages of cybermeans, it is indicated that offensive cyber operations will ensure the deterrence of the enemy or reduce its ability to conduct military operations against the PRC. In addition, with the help of cyber operations, the PRC can manage an escalation of the conflict, in the early stages of the conflict, by attacking and blocking information support and communications and control systems (C4ISR) in the enemy forces or by attacking critical civilian and military infrastructure to deter or disrupt intervention. The development of defensive cyber capabilities in the PRC is also of great importance due to the specifics of counteraction in the information sphere [Jinghua, 2019].[12]

[11]The range of fire of the S-400 air defense system reaches 400 km, and the target detection range is 600 km.

[12]In the cyber domain, after the first round of a cyber attack, the attacked side can respond with an accurate counterattack only if it has a strong defense.

The PRC plans in the coming years to develop capabilities commensurate with its status as a major cyber country [*Military and Security Developments...*, 2021, pp. 77–79]; that is why it integrates offensive and defensive cyber operations and increases the number of joint military exercises that allow personnel to test capabilities.

Actions in the field of electronic warfare (EW) differ from cyber operations in that they are carried out not in the information (cyber) domain but in the electromagnetic spectrum. The electronic warfare strategy focuses on the suppression, destruction, and interruption of the operation of enemy electronic equipment: radars and sensors of data transmission systems that operate at the radio, radar, microwave, infrared, and optical frequency bands. These types of operations are also actively being developed by China. In particular, it was reported that the PRC fielded several types of UAVs with EW payloads, and that PLA EW units routinely train to conduct jamming and anti-jamming operations against communication and radar systems or satellite systems [*Military and Security Developments...,* 2019, pp. 63, 64].

An important element in strengthening the potential of the PRC in electronic warfare and cyber operations was the formation, within the framework of the military reform of 2015, of a separate branch of the armed forces, which combined the entire potential of information confrontation and "intellectual warfare"—the Strategic Support Force (SSF) of the PRC. All forces, missions, and capabilities of technical reconnaissance, space, cyber and electronic warfare, as well as information and psychological warfare, which were previously subordinate to two different departments of the PLA General Staff, were brought together in the SSF [*Military and Security Developments...,* 2021, pp. VII, 77–79; Kashin, 2016]. In fact, the potential for "integrated network and electronic warfare" was created, whereas previously in the PLA, the cyber defence and cyber operations units were not subordinated to the same structure, as well as EW and cyber warfare forces [Costello and McReynolds, 2018]. In addition, SSF,[13] as a separate branch of the armed forces, along with the PLA Rocket Force, obtained powers not only for the construction of their own forces but also for strategic operations. Thus, their status and opportunities for the development of appropriate capabilities increased. Several issues related to SSF development are still not clear (for example, the peculiarities of the PRC doctrine on the use of force in cyber domain, the level of professionalism of the personnel of the units included in the SSF, the effectiveness of ongoing exercises, etc.). However, Western experts generally share the opinion that the PRC has managed to improve its capabilities in the field of cyber defense/cyber attacks and electronic warfare significantly compared to 2015. According to forecasts, this capability will only be strengthened [Costello and McReynolds, 2018; Desai, 2019].

[13]They consist of the Space Systems Department, which is responsible for military space operations, and the Network Systems Department, which is responsible for technical reconnaissance, EW, cyber warfare, and psychological operations.

IMPLICATIONS FOR THE REGION

The capacity growth estimates also apply to the Chinese A2/AD system as a whole. The PLA certainly faces a number of obstacles that make it difficult to take full advantage of the current systems and capabilities of C4ISR and A2/AD. These obstacles complicate the functioning of a unified system of "network management" and information operations. For example, despite the adoption of the latest communications, intelligence, and surveillance systems, as well as the development of the EW, cyber and space warfare potential interoperability problems remain. Furthermore, the troops lack experience in the use of the appropriate technologies and systems. There is also a kind of "technological gap" between PLA units that have the latest high-tech A2/AD systems and equipment and those that do not [Bilsborough, 2013]. But it should be recognized that the overall capacity of China's A2/AD assets has developed rapidly over the past ten years and will continue to strengthen in the coming years [Gompert, Cevallos, and Garafola, 2016]. At the same time, the PLA has goals to be ready to "win in informatized (network) local wars" with an emphasis on confrontation at sea (as they are formulated in the 2015 PRC Defense White Paper) and to win in "intellectual war" of a new type (China outlined such goals for the modernization of the PLA in 2020).

An integral part of China's approach to informatized war will be the information and technological support (in the field of space and cyber operations and electronic warfare) that the strengthening of SSF will provide, as well as the integration into a single system of offensive and defensive operations of other components of the C4ISR and A2/AD systems. These changes will allow the PLA to increase significantly its offensive capabilities against technologically powerful adversaries, including the United States. Through "cross-domain integration," the threat of Chinese attacks using conventional weapons and cyber warfare against various significant civilian targets and critical infrastructure will become a deterrent to possible military operations [Desai, 2019].

For the United States, China's progress in the development of the A2/AD system has already led to consequences in military-political and military-strategic sphere; this is reflected both in doctrines of the use of force and concepts of combat operations, and in principles of deploying US forces in the APR. Generally speaking, the zone of free maneuvering of the combat forces of the US fleet stationed in the APR is being reduced (especially in the seas adjacent to the

PRC), and the operations of military aviation are also being complicated or prohibited. Accordingly, the United States is forced to adjust the principles for deploying its warships, aircraft (strike and reconnaissance), and military and naval bases in the region. The United States recently redeployed the B-52 strategic bombers from the island of Guam in the Pacific Ocean to North Dakota, thereby removing them from a potential strike from Chinese medium-range missiles. In 2020, plans were unveiled to increase funding to the US Indo–Pacific Command to equip joint forces, including those of US allies, with precision-guided (anti ship and anti aircraft) weapons. It is also planned to create, primarily in Guam itself, an integrated air and missile defense and strengthen the groupings of troops in the region [Khodarenok, 2020]. The Joint Pacific Command forces are tasked with preparing for one war between the great powers, in addition to dealing with several smaller conflicts. The change in US views on the principles of conducting operations in the APR is obvious: the country is placing more emphasis on the development of its own C4ISR and A2/AD assets deployed in the region, including electronic warfare, air/missile defense systems, stealth aircraft, cruise missiles, etc.

Many US military analysts share the view that, as Chinese A2/AD capabilities strengthen further, the cost of US losses in conventional forces against China will only increase over time,[14] especially in a scenario of short-term but intense conflict. It is concluded that the United States should rely not on "plans to destroy China's A2/AD capabilities in the first phase of the conflict" but on containment and de-escalation measures, and at the same time on increasing investment in combat platforms with increased survivability and "in the development of its own A2/AD assets" [Gompert, et al., 2016, pp. XV, XVI, 19–21].

The need to counter China as a powerful adversary at sea, that in the past decade has significantly increased the number of ships of the main classes and developed the "sea component" of the A2/AD potential, is reflected in the new US Naval strategy Battle Force 2045, which the US Navy presented in the fall of 2020. Its key aspects were shifting priorities in the development and deployment of the fleet to light forces (frigates, landing ships, unmanned systems) and the submarine fleet, return to the construction of light aircraft carriers, and development of control and communication systems and infrastructure of the "digital battlefield" with the transfer of target designation between units of different types of armed forces in real time [Kramnik, 2022, pp. 157, 158].

[14]Experts compared possible losses primarily in aviation and warships, taking into account the "A2/AD factor." It was noted that the situation will worsen significantly for the United States by 2025 compared, for example, with 2015 [Gompert, et al., 2016, p. 12].

It is noteworthy that the Pentagon plans to solve the corresponding tasks, including blocking Chinese C4ISR and A2/AD assets, not solely at the expense of its own combat forces deployed in the region. A number of them, apparently, could be shifted "to the shoulders" of the US allied countries, first of all, on partners in the APR [Gompert, Cevallos, and Garafola, 2016, pp. 56, 57]. This approach explains such regional military-strategic processes as the strengthening of the air/missile defense of South Korea and Japan with the THAAD and Aegis missile defense systems purchased from the United States, the re-equipment by the countries of Southeast Asia of warships and aircraft with modern radars and surveillance and combat control systems, growing gratuitous transfers or preferential purchases of American UAVs by Southeast Asian countries, etc. All these processes, therefore, not only indicate the growing nature of threats and the intensification of the arms race between the United States, China, and between the APR countries in general, but also become a reaction to the active development of China's reconnaissance and anti-access/area denial systems.

CONFLICT OF INTEREST

The author declares that she has no conflicts of interest.

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