

USS *Chancellorsville* leads PLAN *Shenzhen* into Apra Harbor, Guam, for naval port call

# Information Technology *and* China's Naval Modernization

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In recent years, the modernization of the People's Liberation Army Navy (PLAN) has become a high priority for senior Chinese Communist Party (CCP) leaders and high-ranking military officers. For instance, CCP General Secretary, President, and Central Military Commission Chairman Hu Jintao in a December 2006 speech to PLAN officers underscored the need "to build a powerful People's navy that can adapt to its historical mission during a new century and a new period."<sup>1</sup> Similarly, PLAN Commander Wu Shengli and Political Commissar Hu Yanlin promoted naval modernization in an authoritative CCP journal. According to Wu and Hu, "Since the reform and open door policy, along with the consistent increase of overall national strength, the oceanic awareness and national defense awareness of the Chinese people have been raised and the desire to build a powerful navy, strengthen modern national defense and realize the great revitalization of China has become stronger than at any other time."<sup>2</sup> Moreover, Wu and Hu contend, "To build a powerful navy is the practical need for maintaining the safety of national sovereignty and maritime rights."<sup>3</sup> Such statements emphasize the importance that China's civilian and military leaders attach to PLAN modernization.

U.S. Navy (Christopher S. Borgren II)

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This growing urgency about modernization is focused largely, but by no means exclusively, on a possible conflict over Taiwan. At the same time, Wu and Hu point out that the navy must be prepared for a wider range of missions, including the protection of maritime resources and energy security issues. These missions drive PLAN requirements, not only for the new platforms China is putting into service with the navy, but also for command, control, communications, computers, intelligence, surveillance, and reconnaissance (C<sup>4</sup>ISR) capabilities.

Within this context, enhancing PLAN information technology and communications capabilities is seen as critical to China's overall naval modernization program. According to one recent article, "The informatization of shipboard weapons and equipment is the core of maritime joint combat. . . . [T]he Chinese Navy should vigorously build data links for maritime military actions and fundamentally change the way to carry out tasks in the future," ultimately creating a "networked fleet."<sup>4</sup> Reaching this goal hinges on narrowing the gap between the PLAN and the world's most advanced navies through the development, acquisition, and integration of advanced information technology.

This emphasis on "informatization" derives from the expectation that the People's Liberation Army (PLA) must prepare for local wars under informatized conditions, a theme that was underscored at the 17<sup>th</sup> CCP Congress in October 2007. Specifically, Hu's report to the Party Congress declared:

*To attain the strategic objective of building computerized armed forces and winning IT [information technology]-based warfare, we will accelerate composite development of mechanization and computerization, carry out military training under IT-based conditions, modernize every aspect of logistics, intensify our efforts to train a new type of high-caliber military personnel in large numbers and change the mode of generating combat capabilities.<sup>5</sup>*

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This guidance applies with particular force to the modernization of the PLAN. According to one recent article, for example, "Informatized warfare is the mainstream trend in the development of future maritime wars."<sup>6</sup>

### PLAN "Informatization"

The PLAN is undergoing an impressive transformation from what was essentially a coastal defense force to a more offensively oriented force capable of executing a variety of regional missions in support of China's national security interests. As part of this modernization program, a number of new surface ships and submarines have entered service. New surface ships include Russian-built *Sovremennyy* guided missile destroyers; indigenously developed *Luzhou* and *Luyang* I and II guided missile destroyers; *Jiangkai* I and II guided missile frigates; and the *Houbei*-class missile-armed, wave-piercing catamarans. Among the new submarines are *Kilo*-class diesels acquired from Russia and the domestically developed *Shang* nuclear-powered and *Song* and *Yuan* conventional attack submarines. With the addition of these platforms, the navy is improving its surface warfare, undersea warfare, and air defense capabilities.

The PLAN also appears poised to become an increasingly important part of China's nuclear deterrence posture with the addition of several Type 094 fleet ballistic missile submarines (SSBNs), which will be armed with JL-2 submarine-launched ballistic missiles. According to the 2006 Defense White Paper, the PLAN "aims at gradual extension of the strategic depth for offshore defensive operations and enhancing its capabilities in integrated maritime operations and nuclear counterattacks."<sup>7</sup>

China's leaders perceive their nation to be confronting a strategic environment in which "military competition based on informatization is intensifying."<sup>8</sup> This view both highlights the growing importance of information technology in military modernization and places a heavy premium on striving for information dominance in any future conflict, especially one with a technologically advanced adversary. Some analysts write about the role of information in a style reminiscent of U.S. publications that emphasize information superiority and extol the virtues of "network-centric warfare." For example, according to three researchers affiliated with the PLAN's Dalian Naval

Combatant Academy, "in the information age, information has become one of the main sources of combat power."<sup>9</sup>

### C<sup>4</sup>ISR Systems

Given the Chinese military's C<sup>4</sup>ISR shortcomings in the 1980s and 1990s, the PLAN's informatization drive started from a relatively weak position. For years, the entire PLA, including the navy, faced major shortcomings in its C<sup>4</sup>ISR capabilities. Despite these modest beginnings, C<sup>4</sup>ISR modernization has been under way since the late 1990s, when the PLA embarked on a massive effort to modernize, upgrade, and expand its communications infrastructure. This ambitious project was bolstered by the rapid development of the civilian IT and telecommunications industries. One of the key results of the upgrade was the construction of a national fiber optics network that provided the PLA with much greater communications capacity, reliability, and security. Beijing also intensified its efforts to improve its space-based C<sup>4</sup>ISR capabilities. Indeed, China began an

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ambitious manned space program, started participating in a variety of international partnerships, and moved forward with several military space programs.

Space-based C<sup>4</sup>ISR developments are particularly crucial for naval informatization, especially given the PLAN's evolving missions. According to the 2007 Department of Defense (DOD) report on Chinese military power, "China seeks to become a world leader in space development and maintain a leading role in space launch activity."<sup>10</sup> Navigation and positioning have been other areas of emphasis with implications for military modernization and navy informatization. In addition to using the Global Positioning System and Global Navigation Satellite System and working with the European Union on the Galileo navigation satellite system, China has deployed its own *Beidou* navigation satellites. Chinese developments in small satellites and maritime observation satellites are also of particular interest from the perspective of naval informatization.

Beyond these improvements in space-based ISR capabilities, the PLA is also making major strides in the construction of its communications networks. Indeed, the expansion of military communications networks is a noteworthy aspect of Chinese military modernization and one that has major implications for PLAN informatization. The PLA reportedly has accelerated the development of its nationwide communications capabilities, devoting particular attention to diversifying the means of communication and enhancing security and antijamming capabilities.<sup>11</sup> According to one source:

*in the coastal military commands, a gigantic optic-cable communication network has been set up, which guarantees the optic-cable communication among the headquarters of each military command. Meanwhile, satellite communication has been applied more widely, which ensures smooth communication between the top commanding organ and the headquarters at different levels of the military commands.*<sup>12</sup>

Chinese research institutes have also “developed a VSAT [Very Small Aperture Terminal] communication system consisting of mobile vehicle-borne components” as well as microwave and troposcatter communication systems, and China is also upgrading some of its traditional communications systems.<sup>13</sup>

Improving military computer networks and making them available to more units have been particular priorities as the PLA expands its communications networks, another key “informatization” development that has major implications for the PLAN. Recent reports indicate that all navy units at the division level and above are now connected to military computer networks and that current plans focus on extending coverage to lower-level units.<sup>14</sup> In addition, the navy is improving the capabilities of its ocean survey and reconnaissance ships, which are responsible for such tasks as surveying, gathering meteorological and hydrographic information, laying and repairing undersea cables, and intelligence collection.

### Trends in Research and Development

Further technical improvements are likely over the next decade. According to the 2007 DOD report on Chinese military capabilities:

*To prevent deployment of naval forces into western Pacific waters, PLA planners are focused on targeting surface ships at long ranges . . . One area of apparent investment emphasis involves a combination of medium-range ballistic missiles, C<sup>4</sup>ISR for geo-location of targets, and onboard guidance systems for terminal homing to strike surface ships on the high seas or their onshore support infrastructure.*<sup>15</sup>

Beijing is already developing the capability to target U.S. ships with ballistic missiles, such as the medium-range DF-21.<sup>16</sup> “China is equipping theater ballistic missiles with maneuvering reentry vehicles . . . with radar or [infrared] seekers to provide the accuracy necessary to attack a ship at sea,” according to the Office of Naval Intelligence.<sup>17</sup> If supplied with accurate real-time target data from China’s growing constellation of ISR satellites or other sources, terminal seekers and maneuvering warheads could threaten targets such as airbases and aircraft carriers.<sup>18</sup>

Chinese researchers emphasize the importance of linking platforms into an integrated whole, suggesting that this will remain a focus of defense research and development programs. This is considered particularly important for the PLAN. According to one article, “A platform-centric navy cannot bring into full play the potentials of its sensors and weapons,” but “effective networks formed with multiple platforms and multiple sensors can enable the resources of military strength to grow steadily.” Moreover, “resource sharing among various platforms and coordinated allocation of the resources of all operational forces can enable the currently available resources of military strength to be fully utilized.”<sup>19</sup> According to another article, “In order to effectively fuse all C<sup>4</sup>ISR system elements and achieve a seamless connection

*all navy units at the division level and above are now connected to military computer networks*

from sensors to shooters it is necessary to solve the problems of data integration.”<sup>20</sup> Such statements suggest that networked sensors and data fusion are also likely to enjoy high priority in the next few years.

Unmanned reconnaissance systems appear to be another area of emphasis in Chinese C<sup>4</sup>ISR-related research. Indeed, recent technical articles indicate that scientists and engineers are conducting research on various types of unmanned aircraft systems.<sup>21</sup> Researchers are also working on unmanned underwater vehicles. For example, PLAN researchers are addressing the sonar capabilities of remotely operated vehicles,<sup>22</sup> which could have applications in ISR and other maritime warfare mission areas.

People's Liberation Army Navy *Luhu*-class destroyer *Qingdao* departing Pearl Harbor, 2006



U.S. Navy (James E. Poirer)

## Informatized War at Sea

Planners realize that rapid improvements in the PLAN's hardware will not be fully effective without corresponding increases in the ability of its personnel to operate new systems under combat conditions. This requires the navy to make commensurate improvements in training. In keeping with recent PLA-wide guidance from the General Staff Department that stresses making training more realistic and challenging, the PLAN has emphasized training that simulates the actual battlefield environment as much as possible. Official sources indicate considerable progress in making training more rigorous.

Chinese sources frequently highlight the importance of conducting training under "complex electromagnetic conditions," so forces will be prepared to conduct operations in an environment characterized by jamming, electronic attacks, reconnaissance, and electronic deception. A June 2007 North Sea Fleet exercise reportedly incorporated several of these challenges.<sup>23</sup> The PLAN is also conducting opposing forces training featuring Blue Force detachments playing the role of enemy units and is making extensive use of modeling and simulation as part of its drive to improve training for future informatized conflicts.

Another area of emphasis reflects the conclusion that the military will have to fight jointly in future conflicts. According to the PLAN's official newspaper, "As profound changes take place in the form of war, future warfare will be integrated joint operations under informatized conditions. Training is the rehearsal for war, and what kind of a war we fight determines what kind of training we should conduct."<sup>24</sup> Numerous recent articles highlight the PLAN's joint training activities.<sup>25</sup> Some of these joint exercises have focused specifically on communications capabilities.<sup>26</sup>

## Implications for Jointness

Successful informatization will have major implications for the PLAN's ability to conduct joint operations and for the future development of its command and control system. PLAN publications consistently emphasize the growing importance of joint operations, which many authors connect to the challenges of informatized operations in a complex battlefield environment. Indeed, joint operations and informatization are

expected to play a prominent role in a variety of campaigns in which the navy might be called on to participate. A major PLA doctrinal publication, for instance, emphasizes the need to achieve objectives rapidly in a complex battle environment by jointly implementing an air, maritime, and information blockade.<sup>27</sup> The last entails "actively destroy[ing] the enemy's important ground information installations, disrupt[ing] the enemy's satellite and radio channels, cut[ting] off the enemy's submarine cables and cable channels . . . [and] smashing the enemy's information warfare capability."<sup>28</sup>

Joint campaigns require joint campaign command structures, which are responsible for coordinating service activities in pursuit of the overall campaign objectives. According to another major PLA doctrinal publication, the command and communications systems of troops under the same command or participating in coordinated operations must be interoperable.<sup>29</sup> Technical interoperability of C<sup>4</sup>ISR assets is a necessary, though insufficient, condition for the development of joint operational capabilities.

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*some joint exercises have focused specifically on communications capabilities*

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The PLA still faces a variety of problems, many of them bureaucratic and institutional. Perhaps the most important is a highly centralized and hierarchical command structure and organizational culture that is averse to delegating decision-making to lower levels, much less junior and noncommissioned officers. Another potential roadblock is institutional resistance and bureaucratic opposition resulting from the likely tendency of joint campaigns to emphasize the importance of the PLAN, the People's Liberation Army Air Force, and the Second Artillery Corps, through which supreme headquarters exercises direct command and control over strategic missile forces, and thereby erode the traditional dominance of the army.

Still another challenge is the PLA's lack of real experience conducting joint operations. The only historical example is the relatively small-scale Yijiangshan campaign in 1955; the rest of the PLA's warfighting experiences were at most combined arms campaigns.<sup>30</sup> As the 2006 DOD report points

out, "Although the PLA has devoted considerable effort to developing joint capabilities, it faces a persistent lack of inter-service cooperation and a lack of actual experience in joint operations."<sup>31</sup> In short, the PLAN will likely encounter a variety of challenges as it moves forward with the development of joint operations capabilities. Nevertheless, it has already made considerable progress and is clearly determined to further enhance its ability to conduct joint operations.

In addition to informatization's effect on the navy's ability to conduct joint operations, the introduction and integration of advanced information technology are also likely to influence its approach to command and control. The Chinese military has a tradition of highly centralized command that derives from a variety of sources, including the political system, institutional culture, and organizational structure. Indeed, Chinese scholars argue that the PLA's general staff organizational structure is conducive to centralized command and control.<sup>32</sup> Moreover, for the PLA, unity of command historically has meant centralization of command. This tradition appears to have considerable staying power. According to Major Generals Peng Guangqian and Yao Youzhi, for example, "All the decision-making power and command authority on issues concerning the overall war situation should be centralized to the strategic commander and the strategic commanding authorities."<sup>33</sup>

Given the PLA's long tradition of centralized command, China could choose to use its improved C<sup>4</sup>ISR capabilities to make centralized command function more efficiently and effectively. Chinese authors have certainly recognized the potential of enhanced communications capabilities to enable higher-echelon decisionmakers to function more effectively. High-bandwidth secure communications, for instance, allow strategic leaders to transmit plans and other operational documents electronically in real time and hold videoconferences with subordinates instead of traveling to the front for face-to-face meetings. According to Peng and Yao:

*Under high-tech conditions and with the aid of the strategic command automation system, the form of assigning strategic tasks orally, realized only face to face in the past, can now be actualized between different places, and assigning strategic tasks in the past by written*

*operations documents can now be completed through computer networks in real time.*<sup>34</sup>

There are also strong incentives to consider decentralizing authority, at least to some extent. Notwithstanding the strong emphasis on the role of the strategic commander and the centralized command system, PLA writers suggest that strategic decisionmakers should not attempt to micromanage activities at the tactical and operational levels. For one thing, having more information at higher echelons is not necessarily better; huge amounts of data may simply overwhelm strategic commanders. As Peng and Yao argue, “Under the high-tech conditions, the glut and overload of strategic information have increased to a large extent the difficulties of strategic judgment. . . . [I]t’s not an easy job to retrieve and pick out valuable strategic information when

the total sum of strategic information has greatly increased.”

More broadly, PLA analysts appear to be engaging in a debate about the advantages and disadvantages of centralized and decentralized command systems. Some authors claim that conducting complex joint firepower strikes requires centralized command. They argue that there must be centralized and unified planning, organization, control, and coordination to conduct high-efficiency integrated firepower strikes. They point out that command relationships are complex because

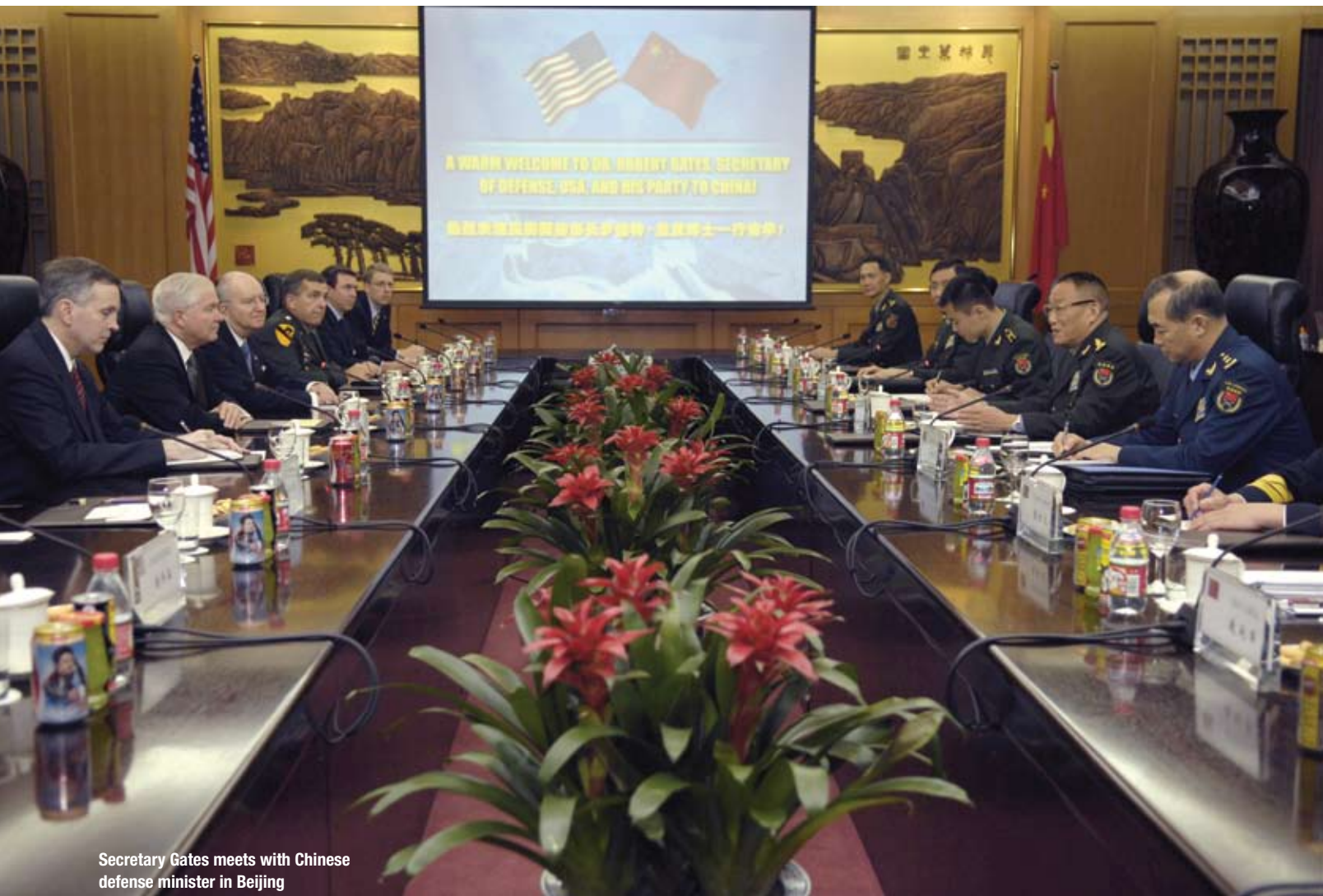
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*having more information at higher echelons is not necessarily better; huge amounts of data may simply overwhelm strategic commanders*

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participating forces belong to different services and branches, and carrying out operational tasks will require temporary partnerships, making organization difficult. Consequently, there must be centralized control of all service and branch firepower strike forces to assure the timeliness, continuity, and coordination of firepower strike operations.<sup>35</sup>

Other PLA writers appear to favor a command and control system that gives greater autonomy to junior leaders on a more routine basis, not just under emergency conditions that impede communications with higher-level commanders. Indeed, the informatization of the PLAN, especially advances in ISR and communications capabilities, may offer China the opportunity to employ a more flexible and responsive command and control system that relies on “directive control” and “mission type orders” to meet the challenges of joint operations in high-tech regional wars.



Secretary Gates meets with Chinese defense minister in Beijing

DOD (Cherie Thurby)

Although adopting such an approach would appear to offer significant operational advantages and complement the PLA's evolving doctrine, a number of obstacles threaten such a dramatic transformation. The most important of these obstacles are the PLA tradition of highly centralized command and control and an organizational culture that does not appear to encourage junior officers to take the initiative. If these hurdles could be overcome, successful implementation of a more flexible command and control system would require the training and development of junior leaders capable of taking the initiative and seizing fleeting opportunities on the battlefield.

How this debate will be resolved remains an open question. To be sure, modern commanders have not always used advances in technology to support the delegation of authority to lower echelons. On the contrary, in many cases, they have sought to use technology to improve the efficiency and effectiveness of centralized command and control. It is entirely plausible that the PLA will pursue this well-trodden path instead of exploiting technological advances to implement a directive control or mission-type orders system, especially given its institutional predispositions. It remains to be seen how the PLA will adapt its command style to changes in doctrine and improvements in information and communications technology. Enhanced IT and C<sup>4</sup>ISR capabilities could permit the PLA to delegate greater decisionmaking authority to lower-level commanders. At the same time, the modernization of the communications infrastructure could just as easily reinforce strong organizational tendencies to favor highly centralized command and control arrangements, as seems to have happened in some recent U.S. military operations.

These are challenges that the entire PLA must confront, but there are also some service-specific issues that navy commanders will need to resolve. First, command and control of PLAN assets is complicated due to the organizational structure of the People's Liberation Army. The commanders of the three fleets answer to both PLAN headquarters and regional military commanders. Second, the deployment of SSBNs will present the supreme command and the PLAN with special challenges. Again, the supreme headquarters exercises direct command and control over strategic missile

forces through the Second Artillery Corps.<sup>36</sup> Presumably, the supreme headquarters would also exercise direct command and control over deployed SSBNs through the General Staff Department or PLAN headquarters.

The navy has been working to achieve secure, reliable SSBN communications for more than two decades. However, the extent to which centralized SSBN command, control, and communications is possible for China across the range of nuclear scenarios remains unclear. This underscores another critical problem for the PLAN: ensuring the ability to communicate with SSBNs in an environment in which its command and control system has been degraded.

### Important Questions

Clearly, the PLAN is serious about the hardware aspects of naval informatization, but at least three broader questions remain unanswered.

**Are Chinese conceptions of informatization unique?** The first question is whether there is anything in the Chinese concept of informatization that is radically different from Western characterizations of the role of information in modern warfare. It is not evident from Chinese sources that there is anything unique about how Chinese strategists view the importance of information and information superiority. Some writings are undoubtedly attempts to assimilate and repackage ideas that are familiar to readers of Western writings on "network-centric warfare," information dominance, and related concepts. Nonetheless, it will be important to watch the trends in PLAN writings and practice to see how these developments play out in both the short and long term. Of perhaps most critical concern would be any evidence of radically different, asymmetric approaches to informatization and the attainment and exploitation of information dominance that could offer China presently unforeseen and potentially disruptive military capabilities.

**How informatized does the PLAN really need to be?** The second broad question centers on how close the Chinese are to achieving the so-called informatized force. The 2006 Defense White Paper established a goal of being able to fight and win informatized wars by the mid-21<sup>st</sup> century. This reflects a perceived gap between the Chinese armed forces and the world's most advanced

militaries, which Chinese writers suggest will take decades to overcome. But it also raises the issue of distinguishing between the "ideal" capability the Chinese military seeks for the long term and a "good enough" capability for the relatively near term.

For the most part, Chinese analysts tend to overestimate U.S. and Western capabilities and portray themselves as backward in comparison. Certainly, many Western observers continue to denigrate PLA capabilities and note that even some of the Chinese military's recent achievements are relatively simplistic by American standards. But one should ask whether a relatively simple system of deconfliction by time or geographic area with disparate platforms might actually be sufficient for the PLA to achieve its objectives under most circumstances. The need for an exquisite C<sup>4</sup>ISR system should not be overstated. In short, if the PLAN has a different metric for integrated C<sup>4</sup>ISR than that of the U.S. Navy, it might achieve an employable capability with surprising rapidity, especially if it pursues one that is relatively crude by U.S. standards but that is nonetheless sufficient to meet China's operational objectives.

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**How will the PLAN resolve two critical informatization-related debates?** Perhaps most interesting in the Chinese writings examined are the ongoing debates arising from increased informatization. One major debate concerns the offense-defense balance in information warfare. The conceptual goal is obviously full information assurance for one's own forces and complete information denial to the enemy's forces. The more likely outcome is some position between the extremes, depending on capabilities and geography. One could posit that information assurance tends to favor short-range operations close to home, where one can rely on land lines and high power line-of-sight communications, while information denial might predominate at long range away from home, where one becomes reliant on satellite communications and long-range signals that might be jammed or geolocated. It will be interesting to follow the progress of this debate

in Chinese writings, especially as strides are made toward creating a more powerful navy, potentially with blue water capabilities.

In this vein, a key possibility that planners must consider is that the PLAN's continuing development of modern C<sup>4</sup>ISR capabilities will not only enhance its ability to operate effectively, but also increase its vulnerability to command and control warfare. As the navy becomes more reliant on high-tech C<sup>4</sup>ISR systems, it must be prepared to contend with electronic, computer network, and kinetic attacks designed to disrupt or deny its ability to use these new capabilities. Indeed, the PLAN—along with the rest of the military—will likely need to devote just as much attention to protecting its own C<sup>4</sup>ISR capabilities as it will to degrading or destroying those of its potential adversaries. The Chinese appear to be pursuing both efforts with equal vigor, practically and theoretically. PLAN writings do not yet offer a definitive assessment of this problem, but it would seem to be important for future Chinese naval operations, including PLAN power projection.

The second debate concerns the appropriate balance between centralization and decentralization. The conceptual goal for most militaries is centralized planning and decentralized execution—that is, empowering the lowest levels with information so they can leverage superior tactical training and initiative. Certainly, the practical experience in the West does not always match this conceptual goal; often, the reality is that “commanders who can control, do control.” This is an issue that has been raised in Chinese writings—with the proverbial 10,000-mile screwdriver as evident to PLA analysts as it is to their Western counterparts. Decentralized operations will likely be an even more difficult issue for the PLA, which is not known for valuing and cultivating battlefield initiative. Nonetheless, PLAN “connectivity” theories and efforts appear to have provoked a debate between advocates of centralization and proponents of decentralization. This controversy is unresolved, and it remains to be seen whether the PLAN will use its enhanced C<sup>4</sup>ISR capabilities to push information down to lower levels and empower junior commanders to make decisions or instead will attempt to leverage new ISR capabilities and growing communications capacity to further strengthen centralized command and control—an option more consistent with the traditional Chinese approach.

The overall implication could be that Beijing is on a path to conduct highly effective centralized operations close to China itself. This may be useful in an access denial role, but it might also be an effective limitation on future power projection, in which information assurance decreases with distance. Clearly, the evolution of the theory and practice of Chinese naval informatization will merit careful observation in coming years. **JFQ**

#### NOTES

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<sup>2</sup> Wu Shengli and Hu Yanlin, “Building a Powerful People's Navy That Meets the Requirements of the Historical Mission for Our Army,” *Seeking Truth*, no. 14, July 16, 2007.

<sup>3</sup> *Ibid.*

<sup>4</sup> Liu Jiangping and Zhui Yue, “How to Reform the Navy in Order to Execute China's Maritime Strategy in the 21<sup>st</sup> Century,” *Modern Navy* (June 2007), 6–9.

<sup>5</sup> Hu Jintao, Report to the Seventeenth National Congress of the Communist Party of China, October 15, 2007, available at <[http://news.xinhuanet.com/english/2007-10/24/content\\_6938749.htm](http://news.xinhuanet.com/english/2007-10/24/content_6938749.htm)>.

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<sup>7</sup> Information Office of the State Council of the People's Republic of China, *China's National Defense in 2006*, December 29, 2006.

<sup>8</sup> *Ibid.*

<sup>9</sup> Ji Chengxin et al., “Some Ideas of Naval Service Equipment Information Modification,” *Journal of the Academy of Equipment Command & Technology* 17, no. 1 (February 2006), 10.

<sup>10</sup> U.S. Department of Defense (DOD), *Military Power of the People's Republic of China, 2007*, Annual Report to Congress (Washington, DC: Office of the Secretary of Defense, 2007), 42, available at <[www.defenselink.mil/pubs/pdfs/070523-China-Military-Power-final.pdf](http://www.defenselink.mil/pubs/pdfs/070523-China-Military-Power-final.pdf)>.

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<sup>12</sup> *Ibid.*

<sup>13</sup> *Ibid.*

<sup>14</sup> Wang Feng and Yang Yuwen, “Navy's Comprehensive Military Information Network Officially Established,” *People's Navy*, August 28, 2006, 1.

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<sup>16</sup> Robert Hewson, “Chinese Missiles Raise Their Game,” *Jane's Navy International*, January 1, 2007.

<sup>17</sup> Office of Naval Intelligence, “Seapower Questions on the Chinese Submarine Force,”

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<sup>18</sup> Eric A. McVadon, “China's Maturing Navy,” *Naval War College Review* 59, no. 2 (Spring 2006).

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<sup>20</sup> Li Qiang et al., “Research on Data Integration of C<sup>4</sup>ISR System,” *Command Control & Simulation* 28, no. 4 (August 2006), 29–32.

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<sup>23</sup> Mi Jinguo and Jiang Xiangjie, “Soul-Stirring Training Carried Out by PLA Naval Forces in Complex Electromagnetic Environments,” *People's Navy*, July 3, 2007, 1.

<sup>24</sup> Zhang Jian and Yuan Zhenjun, “Data Platform Links to Three-Dimensional Battleground,” *People's Navy*, August 4, 2006, 1.

<sup>25</sup> For example, Cha Chunming et al., “From Scene Where PLA Navy Conducts an Informatized Joint Drill,” *People's Navy*, September 1, 2006, 14–19.

<sup>26</sup> Li Fuxiang and Wu Dengfeng, “Navy Organizes Multi-service Arm Maritime Combat Communications Exercise,” *People's Navy*, August 16, 2006, 1.

<sup>27</sup> Zhang Yulang et al., ed., “The Joint Blockade Campaign,” *The Science of Campaigns* (Beijing: National Defense University Press, 2006), 10.

<sup>28</sup> *Ibid.*, 11.

<sup>29</sup> Peng Guangqian and Yao Youzhi, ed., *The Science of Military Strategy* (Beijing: Military Science Publishing House, 2005), 265.

<sup>30</sup> *Joint campaigns* involve the participation of forces from more than one service, while *combined arms campaigns* involve the participation of multiple branches from a single service. For full definitions, see Joint Publication 1–02, *DOD Dictionary of Military and Associated Terms* (Washington, DC: DOD, April 12, 2001, as amended through September 17, 2006), available at <[www.dtic.mil/doctrine/jel/doddict/index.html](http://www.dtic.mil/doctrine/jel/doddict/index.html)>.

<sup>31</sup> DOD, 16.

<sup>32</sup> Peng and Yao, 253.

<sup>33</sup> *Ibid.*, 268.

<sup>34</sup> *Ibid.*, 262.

<sup>35</sup> Zhang Shuhui, “Revelation to Weapon Equipment Construction Based on Integrative Joint Firepower Strike,” *Journal of the Institute of Command and Technology*, 2007, 2.

<sup>36</sup> *Ibid.*, 255–256.