Enlightenments from Cloud Computing Technology to the Construction of Aviation and Space Information Equipment System

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Abstract. Cloud operation is a new operational mode brought by cloud computing technology in the military field. In the future aviation and space information warfare system confrontation, cloud operations will have the invisible power application and the combination of virtual and real combat operations. Based on the concept of cloud computing and cloud operation, this paper analyzes the construction requirements of aviation and space information equipment system. Based on cloud operation, aviation and space information equipment system is constructed. The paper discusses the enlightenment of cloud computing technology and cloud operation concept to the construction of aviation and space information equipment system. The revelations are Emphasizing the research on the winning mechanism of cloud operation, enhancing equipment fusion capability, focusing on reliability and safety, adhering to overall coordination, etc.

1. Introduction

With high-level advantage, broad and innocent space attributes and inexhaustible resources, aviation and space has increasingly become the strategic commanding height of the world's major military powers. Cloud operation is a highly information-based operational concept built on cloud computing technology. It is a new application of big data and cloud computing technology in the field of joint operations. It can also be regarded as further evolution of the concepts such as network-centric warfare, networked cluster warfare, etc.[1-5]

The aviation and space information equipment system is the material basis for supporting the aviation and space cloud operations, and it is the premise of advantages of cloud operations, for example, gathering invisible, virtual and real. Based on the comparison of the concepts of cloud computing and cloud operation, this paper analyzes the construction requirements of the aviation and space information equipment system, and builds an aviation and space information equipment system based on the concept of cloud operations. This paper explores the enlightenment of cloud computing technology and cloud operation concept about the construction of aviation and space information equipment system by focusing on the research on the winning mechanism of cloud operations, adhering to overall coordination and combat demand, improving equipment fusion capability, attaching importance to reliability and safety, etc.

2. Cloud Computing and Cloud Operations

Cloud computing virtualizes service resources such as computing, storage, and networking, and integrates them fast by network, providing a new on-demand provisioning service resource delivery and usage model. Cloud computing can effectively realize the rational use of resources and meet the needs of flexible services. At present, human society has entered the era of cloud computing with main
features of information interaction, mobile Internet, Internet of Things, big data and Web2.0[6]. In the military and defense fields, the United States is the first to promote and apply cloud computing technology. In July 2012, the US Department of Defense released the "The DoD Cloud Computing Strategy." The strategy calls for the transformation of the Department of Defense's current web applications into a cloud environment by the creation of some core data centers and the use of commercial services. From this, the state of the Department's existing web applications shifts to a more flexible, secure, and more efficient service environment to respond quickly to changing mission demands [7]. Experts estimate that the use of cloud computing technology will reduce the cost of hardware and software purchases and operations in the next six years by 20-25%.

In April 2013, the US Department of the Navy issued a memorandum on "The Navy Goes to Cloud Computing." According to this memo, the US Navy will use cloud computing technology as a core part of its information technology strategy. The US Air Force, which has the highest degree of informatization, introduced cloud computing into the field of combat for the first time in the same year, and proposed the concept of “cloud operation”, which was quickly recognized by the US Department of Defense, the Navy, and other services, and became the third “offset strategy” in the United States. One of the core concepts [5]. As a subversive technology that can “change the rules of the game”, cloud computing has its impact on future operations not only in the information technology itself such as the acquisition and processing of battlefield information, but also in profound changes to the gathering and use of combat forces.

By establishing an efficient, fast, intelligent, and secure information network system, cloud operations not only integrate the computing power of servers within the network, but also quickly exchange data from various battlefield dimensions and operational links through command, control, and intelligence, surveillance, and reconnaissance networks, which integrates the operational forces of each combat system to enhance its effectiveness and achieve economies of scale. Cloud operation is the form of operation application of the combat cloud. The main capabilities of cloud operations should include: rasterized information networks, reconnaissance, computational decisions, offense/defense, and comprehensive support.

3. Aviation and Space Information Equipment Needs to be Built into the System
The future aviation and space battlefield is very important for the modern army in shaping the battlefield situation, managing and controlling the crisis, containing and winning the war[8]. At present, major countries in the world have formulated aviation and space development strategies and developed aviation and space military forces. They attach great importance to security threats from aviation and space, seek global strategy initiative, and compete fiercely for the advantage of aviation and space. Strengthening the construction of aviation and space forces not only provides valuable opportunities for the military to achieve modernization and informationization, but also puts forward higher requirements for the construction of equipment systems in the aviation and space battlefield [9]. Studies have shown that the actual cost of the early conceptual analysis and design phase of the system only accounts for 20% of the total life cost, but the impact on the life cycle cost and schedule is as high as 85%. Moreover, nearly 70% of resource allocation decisions occur in the concept Analysis and design phase[10]. As a systematic system, the system approach has caused profound changes in the military field, and has had a major impact on the mode of operations and the form of warfare.

On the one hand, the idea of equipment system can enable us to foster strengths and avoid weaknesses, concentrate on solving the main contradictions of the system, and make the operational effectiveness of the equipment system and the main combat technical indicators meet the mission needs. On the other hand, the idea of the equipment system can make us less utilitarian, solidly start from the basic technology research and development, and break through the core technology which is subject to the dilemma of the opponent. Based on this trend and requirements, the planning, research, development, allocation and use of aviation and space information equipment must proceed from the overall situation of the system, based on the improvement of the core competence of the aviation and space information equipment system - combating effectiveness.
4. Information Equipment System Based on Aviation and Space Cloud Operations

Aviation and space information equipment system must have the following advantages, excellent structure, excellent information operational capability and confrontation ability, strong robustness modular reorganization capability adapting to the needs of aviation and space diversified military missions, conforming to the profound changes of aviation and space operations. The equipment system will be the premise of realizing aviation and space security strategy, peaceful development and utilization of aviation and space, be the basis of future aviation and space system confrontation and response to aviation and space security threats, be the manifestation of combat effectiveness in the field of aviation and space combat.

![Equipment System Diagram](image)

**Figure 1.** Aviation and space cloud operational information equipment system

According to the capability requirements of aviation and space operations, and the requirements of systemization and fusion of the information equipment system, the future cloud operational information equipment architecture of system is shown in Figure 1. The equipment system is mainly divided into operational application layer and operational resource layer. According to the cloud operational process, the operational application layer will be divided into reconnaissance perception cloud, command and control cloud, offensive/defending cloud, and service and equipment support cloud. According to different operational scenarios, from the two dimensions of space and effectiveness, the operational resource layer aggregates operational resources of different types, quantities and sizes to form corresponding operational function clouds.

Reconnaissance Perception Cloud. For multi-dimensional interaction of battlefield, the equipment system must have the global real-time situation acquisition capability. Aviation and space cloud operations will be launched simultaneously in multi-dimensional space. The acquisition of initiative will rely more on the timely acquisition of battlefield information and rapid decision-making for
command and control. Reconnaissance perception cloud provides information support for precise command and efficient use of forces.

The formation of the aviation and space cloud operational equipment system must rely on the cloud-based distributed operational resource management, which manages the operational resources belonging to different military services, departments and regions, and dynamically organizes and dispatches the equipment resources according to the capability requirements of the cloud operations. The systematic development and construction mode of equipment based on the cloud computing model and cloud combat capability requirements will help to break through the limitations of the sector-based construction of various departments, and avoid the phenomenon of low-level redundant construction and waste of resources caused by departmental impulses. The advantages of distributed computing and command and control forces in the equipment system will make the command and control process of the aviation and space battlefield more flexible and robust.

The aviation and space cloud operational equipment architecture involves the army, navy, air force and other military forces. In normal times, according to the characteristics and requirements of the aviation and space cloud operations, the various services carry out equipment construction and internal training under the guidance of the superior department. In wartime or joint training, the forces are compiled according to the needs and aggregated into corresponding functional combat clouds, commanded by the joint command of aviation and space.

5. Enlightenment for the Construction of Aviation and Space Information Equipment System

In the face of the increasingly complex aviation and space security situation and challenges, the construction and development of the aviation and space information equipment system often faces a dilemma. On the one hand, according to the diversified mission requirements and complex security situation, the construction of information equipment must develop a systematic and convergent development model to avoid the lack of overall planning. On the other hand, in the case of large equipment development costs, high risks and limited budgets, there must be some emphasis and trade-offs.

5.1 Pay Attention to the Research on the Winning Mechanism of Cloud Operation

The starting point and the foothold of the equipment system construction is the combating power equipped in the equipment. The concept of cloud operations is the manifestation of the development of information technology such as big data, cloud computing, and artificial intelligence in the military. For a new combat mode, in-depth study of the characteristics and winning mechanism of air and space cloud operations is the premise of the principle of capacity-based and demand-based on the construction of aviation and space information equipment system.

5.2 Establish an Equipment Development Concept that Meets the Needs of Cloud Operations

Demand is the important traction in the construction of equipment systems. The cloud operation capability of the information equipment system largely depends on the abilities of information equipment to be integrated into a combat cloud. The ability to integrate includes not only the ability to integrate into the cloud in physical space and information space, such as improving its modularization, standardization, and intelligence, but also the ability to integrate in a broad sense, for example, the fusion of mature technology and technology to be researched, the combination of existing technology and emerging technology, and the fusion of expert experience knowledge and artificial intelligence in the system analysis level. Therefore, the "fusion" here is a fusion of all factors, deep levels, and continuity.

In the process of aviation and space operations, the capability of the information equipment system is no longer a superposition of the operational capabilities of a single information equipment, but its comprehensive ability to exist in the system. When determining the performance indicators of specific equipment in the information equipment system, it should increase the proportion of capability fusion into the combat cloud according to the requirements of cloud operations. Such as the degree of standardization of data interfaces, heterogeneous fusion capabilities of information equipment, data
fusion and information processing capabilities, and indicators of interconnection, interoperability, interoperability.

5.3 Pay More Attention to the Reliability and Security of Information Equipment System
The development of everything has two sides. The dependence of the combat cloud on communication networks and information technology makes it more susceptible to interference and attacks. Attacks on the information space will lead to the failure of physical equipment, which poses new challenges for the construction of information equipment systems and their operational use in aviation and space battlefields [11][12]. The open, modular, military-civilian interoperability trends have led to an increase in the security risks of the equipment system. In addition, the attacker's system vulnerability discovery capability and attack technology are also constantly improving, making system security threats increasingly upgraded. Therefore, it is necessary to grasp the balance between the application of information technology and the security risks it may bring. Strengthen the development and application of communication monitoring and control between equipment interfaces and new network security protection technologies.

5.4 Balance the Relationship Between Independence and Technology Introduction
Aviation and space cloud operation is a new combat style and operational concept based on the development of information technology such as big data and cloud computing. The core technical system supporting the construction of equipment is an important foundation for the construction of information equipment systems. At present, major countries are vigorously developing disruptive technologies that can greatly enhance the military capabilities. At the same time, they use national power to suppress technological innovation in emerging countries and maintain their technological hegemony and technological monopoly status as much as possible [13]. Therefore, for the core technology and equipment technology that may form a latecomer advantage, we must advance the layout, advance planning, and take the initiative in our own hands, adhering to the dominant position of information technology, adhering to systematic development, and adhering to independent innovation.

At the same time, it should be recognized that as a complex technical system, the technical challenges of core information equipment can not be completely solved in a short time. It is not in accordance with objective laws that a country fully grasps all the technologies in the technical system, and there are also huge time and economic costs. Therefore, in the construction and development of information equipment, we should balance the relationship between independence and utilization of the global industrial chain, and explore the great potential of military-civilian fusion. While focusing on core technologies, we should also pay attention to the development of basic and supporting technologies.

6. Conclusion
The future informationized warfare cannot be separated from the support of information and equipment such as aviation and space early warning, reconnaissance and communication, especially the rapid development and wide application of information equipment technology. The aviation and space equipment not only participates in upstream operations of information acquisition and transmission, but also enters into information processing, application and other midstream links. In the future, information equipment will even be directly involved in the final stage of firepower strikes.

This paper analyzes the relationship between cloud computing and cloud operations, analyzes the capacity requirements of aviation and space cloud operations, and studies the composition of aviation and space information equipment systems based on cloud operations. The enlightenments of the construction of aviation and space information equipment system are discussed, based on the technical nature of cloud computing and the concept of cloud operation.

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