Command and Control System Construction in Big Data Era

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Abstract. The definition and characteristics of big data are summarized. From the era of big data, the production of command and control system data leads to 3 issues of data storage and processing, situation generation and decision-making, and data visualization. It takes the construction of a big data center and discusses the basics. The accusation framework and the coping strategies adopted by cloud computing under big data conditions provide reference for the application of big data technology in command and control systems, and point out the development trend of the next instruction system.

1. Introduction
Since the 1990s, with the rapid development of information technology and network, the rapid popularization of the Internet and the explosion of global data, the information ecology is increasingly complex, and there is a large amount of data beyond people's ability to absorb and digest. Therefore, "big data" emerges to find the applicable information needed in a large amount of data, and it has a significant impact on all aspects of our lives.

With the rapid development of military technology, networked warfare is becoming the mainstream of combat mode. Command and control (C2) systems have also gone through the transition from platform-based and rule-based to networked and intelligent. At the same time, the development of C2 system is also plagued by the real-time processing of a large number of various kinds of data. On the other hand, there are also many problems in the construction of the system under the big data, and the problems in the aspect of security need to be solved urgently. It can be said that "big data" has become a hot research issue in the field of C2. This study analyzes some problems in the construction of C2 system based on big data, and gives corresponding solutions in the aspects of architecture, real-time mass calculation and data security, which points out a direction for the development trend of the next generation system of our army.

2. Big data
A research institution named Gartner pointed out that "big data" requires new processing modes to motivate stronger decision-making, insight and process optimization ability that can adapt to massive, high-growth and diversified information assets [1]. With the massive accumulation of data in the network era, "big data" naturally attracts high attention in the military field, pushing the new military revolution towards a deeper development. At present, joint operations have become the main combat style of wars, and the large number of sensors applied on the battlefield also bring massive data. How to find useful information in the data ocean and transform information advantages into decision-making advantages is an important research topic in the "big data era".
In the age of big data, it is often not required to know every precise detail exactly, but to know the general picture of things. Through the massive accumulation of relevant data information rather than the accurate analysis of a kind of specific data, a large amount of data can be used to extract the rules of the operation of things and judge their development trend [2].

As a methodology, "big data" essentially makes data serve our decisions, and it has five significant features, namely, the 5V proposed by IBM. 1) Volume: the amount of data on the battlefield is usually calculated at PB, EB or higher levels, and its size determines the value and potential of the data considered; 2) Velocity: the battlefield situation changes rapidly and the speed of obtaining large amounts of new data is extremely fast, which requires real-time analysis and processing; 3) Variety: various types of sensors and various data sources generate various data types, including structured data, semi-structured data and unstructured data; 4) Value: the real data needed in the large amount of battlefield data is very limited, and the rational use of big data creates high value with low cost; 5) Veracity: the quality of data [3].

3. Command and control system

As the "multiplier" of military combat effectiveness, the C2 system adjusts the ongoing theme activities through the interaction among people, machines and environment, as well as input, processing, output and feedback of information. In the development process from C2 system to C3, C3I, C4I, C4ISR and GIG, the US military achieved a leap from centralization to platform-centric to network-centric [4-5]. Under the background of "big data", only the analysis and grasp of the data can constantly improve the ability of "from data to decision-making" and approach the combat target of "discovery is destruction".

3.1. Data sources

3.1.1 Battlefield intelligence surveillance

The data generated by various sensors on the battlefield contain abundant operational information, which has great significance for analyzing the status of target and the combat attempt, and monitoring the enemy action. However, with the continuation of target tracking and monitoring activities, the data volume generated has also increased exponentially.

3.1.2 Combat command and control

The analysis of real-time situation in the battle field, the command and command of superiors and various guarantee information also generate a large amount of heterogeneous data. Through the fusion and mining of these data from different sources, data association and decision support can be realized and the effective control of situation can be realized [6].

3.2 Current problems

3.2.1 Data storage and efficient calculation

Big data puts quite high requirements on the data storage capacity of C2 system, but the various types of data perceived that are usually include not only useful information features, but also other features of redundancy. Therefore, the information sampling amount is huge and the information fusion is slow, and the prediction planning is slow and execution is weak [7]. As a result, the current system still has problems such as weak interoperability and poor information processing capacity.

On the other hand, many semi-structured or unstructured data describing the complex tactical meaning of the battlefield, including data that cannot be presented through data, such as text, pictures, and various types of reports and graphics, are difficult to use. Also it is difficult to use traditional database with a fixed format for storage and corresponding tools to analyse data. The lack of analytical ability for these data makes it difficult to extract useful information from these low-value-density data, which seriously restricts the development of the accusation system [8].
3.2.2 Situation analysis and decision support
In the era of big data, for modern accusation systems, how to establish a qualitative and quantitative comprehensive decision-making model based on rules and probabilities and reflecting the objective situation becomes more and more important on the basis of fully understanding the logical relations of exclusion, attraction, competition and risk between the components and their interference components.

In the traditional concept of platform-centric warfare, each platform mainly relies on its own detectors and weapons to combat. The platform and the platform can only share a small amount of information through a limited number of methods, and cannot be distributed in a wide area. Various detectors, command centers and various weapons are combined into a unified and efficient large-scale system to realize the battlefield situation and the sharing of weapons [9].

3.2.3 Data visualization and predictive analysis
Traditional local deduction, on-the-spot deduction and sand table deduction can help the commander master the comprehensive situation of the battlefield and then determine the operational determination. However, in the face of information warfare, it is gradually unable to meet the needs. Visual data can let users intuitively feel the role of data and help command intuitively grasp the battlefield situation and make quick decisions [10]. Extensibility and dynamic analysis have always been the two main challenges of big data visualization. On the one hand, most of the data sets have strong correlation, and it is difficult to separate and display independently. On the other hand, dynamic visualization has high performance requirements. Although large-scale heterogeneous data and high-latitude data will affect the development of data visualization, and it is difficult to analyze, but large amount of data can extract the law of the operation of things, and judge its development trend, and make forward-looking judgment through data. Commanders at all levels use data effectively to improve data usage accuracy.

4. Further development direction
The development of big data brings severe challenges to the development of C2 system. In combination with the application of big data technology, corresponding suggestions are put forward from three aspects of big data center, cloud computing and data security.

4.1 Big data center
As the core foundation for the application and efficiency of big data technology, the big data center is an inevitable stage for the construction of a new generation of C2 system, which is mainly used for the storage and management of big data.

The business data in the command information system has many kinds of different features and characteristics of each are not identical. It is necessary to formulate the normative and corresponding standards between the data, perform standardization and scientific management like a library, and carry out scientific research on data through standardized processes and format storage methods. Effective management to order to improve the quality and efficiency of data usage and to coordinate all types of structured, semi-structured and unstructured data. On this basis, the cloud storage technology and the distributed file system are combined to ensure single-point access and global sharing of information resources to meet the requirements of continuous operation, elastic capacity expansion and load balancing.

The C2 system architecture oriented to big data should comprehensively consider the resource layer, capability layer, platform layer and management layer, and constitute the accusation system architecture as shown in figure 1 under the support of the underlying technology.
4.2 Cloud computing

How to build a coordinated combat system with efficient real-time battlefield situation processing capability, resource collaborative management capability, dynamic distributed cooperative control capability and high-speed data transmission processing capability is the top priority of "fighting and winning battles". When faced with a complex combat environment, the OODA ring is completed faster and takes the initiative, that is, S OO cycles and one DA ring [11], as is shown in figure 2.

Constant observation -- judgment requires a lot of data processing, with the new military reform and the development of information technology, cloud computing becomes the inevitable choice of C2 system.

Big data cannot be separated from cloud computing, which also supports the processing of big data. In particular, the relationship between the big data and cloud computing like the face of positive and negative of a coin that is inseparable, big data must adopt distributed architecture, relying on distributed processing and distributed database of cloud computing and cloud storage, virtualization technology [12], including using HBase store data, NoSQL database, MapReduce model, etc. [13]. Big data must be calculated through distributed data mining of massive data to provide data support in information fusion, situational awareness analysis, and decision support [14].

In the process of data processing, H. A. Simon puts forward a countermeasure to homogenize heterogeneous data, conceptualize non-conceptual problems, minimize human error through feedback from C2 systems, and maximize the effectiveness of machines and environments in 1978. His theory named limited reason that the non-conceptual and unstructured components in an infinite range can be extended into a flexible concept and structured component processing that can be operated in a limited time and space. This can linearize and satisfy the nonlinear and uncertain systems, and then correlate surface-independent things together [15].
4.3 Data security
The US military applies cloud computing platform to C4ISR system. The analysis shows that the existing cloud computing platform can meet the reliability and expansibility of the operation of battlefield data processing software, but the requirements of data privacy and security cannot be met yet.

Future wars have the basic characteristics of big data warfare. The victory and defeat of war increasingly rely on large, systematic and highly credible scientific data. The comprehensive analysis of big data has become the commanding height of military field competition, but if the core data resources cannot be properly protected, may be subject to cyber-attacks with serious consequences that once compromised. Under the support of big data technology, massive information base has become the condition of cyber-attacks, and military systems and data systems will become targets. Therefore, the protection of military core data by legitimate means and the prevention of enemy intelligence gathering activities on its own core information has become a difficult point with C2 system in the big data era.

5. Conclusion
As an important part of the new military power system, the command and control system has an extremely important position and role. In the era of big data, all kinds of combat power and sensors that collect the amount of data are bigger and bigger, the speed of generating data is getting faster and faster, and the timeliness of data processing is also getting higher and higher. The integrated C2 system will rely on the big data management platform to provide support for data mining and processing, generating situation and information sharing, and achieving data winning. At present, the research results on the application of big data in the C2 system are updated quickly, but at the same time, they also face some problems. The timely summary of these new achievements and problems has important reference significance for constructing the command information system of our military.

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