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# Design and Implementation of General Source Simulation System Architecture

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***Abstract*—Equipment development and daily training of C2 system need simulation intelligence which are provided by simulation system. This paper put forward a whole system architecture and integration framework which can improve the develop efficiency of source simulation system on the basis of the using demand analysis of simulation system. This may satisfy the demand of system flexibility and rapid deployment..**

***Keywords-simulation system; system architecture; integration framework***

## I. INTRODUCTION

In present, the gap of our army and foreign in the field of informatization remain large. For accelerating informatization construction of our army, it is need to develop and equip C4ISR system of various types and different levels. Information processing is the kernel of the whole C2 system and the basis of command and decision-making of the commander. Information processing system is the most important in every construction of C2 systems. In order to support and verify the development and construction of system, it needs various types of simulation information intelligence to ensure the development and implementation of information processing better. In the process of equipment training and daily training, it also need the information simulation system to provide various types of intelligence.

According to current situation of the above and starting from the actual demand, for the existing simulation system for reference, the paper not only research the architecture design of information simulation system and put forward a set of general architecture models and development platform based on component which includes foundation support service platform, general business, special business, but also introduces the design and implement of general simulation application integration framework which aims at the rapid development of single simulator.

## II. USING DEMAND

Although the different demands of information simulation systems and the ever-changing functions and performances, the most basic demand is invariable which is producing various kinds of simulation information to develop C2 system and ensuring daily training. It can resolve basic function components from this basic demand which include basic data maintence, scenario editing, simulation engine, force produce, simulation intervene, situation display, information creation, etc.

Although as a type of fight simulation system, but information simulation system is different from fight simulation system in general. Information simulation system does not emphasize the fight confrontation between two or many parties and weaken the request of fight models relatively. Information simulation system may simplify the process of fight models according to the actual situation and establish in the various information creation. In this way, it can reduce the difficulty of system development and be beneficial to the realization and deployment of system.

Information simulation system takes more emphasize on the graphical user interface, operational ease, low cost and rapid development. From the perspective of the general, information simulation system chooses the PC , Windows, Oracle, MS SQL Server as its OS and database.

Meantime, it should fully consider the compat and use of existing simulation software. The past simulation software with single function can interconnect the new system by the way of remaking interface or adding agent.

## III. DESIGN OF ARCHITECTURE AND FUNCTION MODULE

Information simulation system uses modular module design method on the basis of design of architecture. This is convenient for flexible combination in each function modules and adapt to different application demand. The system can be divided into three levels as showed in Figure

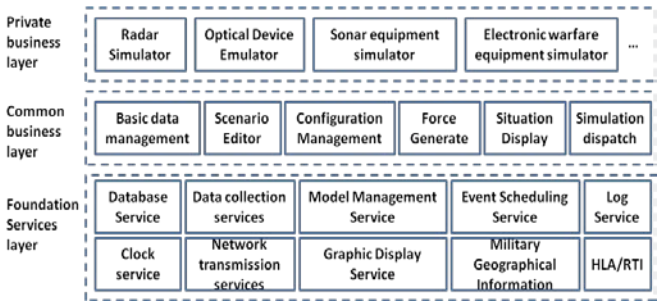


FIGURE I. SOURCE SIMULATION SYSTEM ARCHITECTURE

- Infrastructure services layer: Providing all kinds of basic service functions which is needed by simulation system.

- General business layer: This is a essential part for all simulation systems. Basic data management and scenario editor are responsible for data preparation. Config is responsible for the config data management of whole system host machine, seat, network, etc. Simulation guide is responsible for the control of simulation process and interact objects in real time.

Situation display is responsible for show position and status of all the simulation objects on the map to give reference to operating personnel.

- Dedicated business layer: This is composed of detect simulation systems which creating all kinds of intelligence data. Seats can be choosed and are settled according to specific information demand.

This kind of hierarchical design realizes highly flexibility, scalability and rapid deployment for simulation systems.

- The six function modules in general business layer can be simplified deployed on one seat in the smallest mode.

- The dedicated simulation seats are cutted according to the produced intelligence. These simulators order and receive their each datum by RTI and then simulate and handle it to create simulation intelligence with different levels and types.

- According to different demands such as scale, performance and complexity of simulation system, force generation seat may be further refined. Force generation seat can be divided into army simulation seat, navy simulation seat and air force simulation seat to simulate three kinds of object actions. Some objects can be independent from force generation and be maked to independent simulators to simulate the fight operations more vividly . Such as spatial objects, ballistic objects, aircraft carrier, unmanned plane, etc.

## IV. DATABASE DESIGN

Design of database is also an important component of the whole system architecture. Because of the various functions in simulation system, data requirements of each subsystem are very different. System databases are divided according to business functions for constructing general information simulation system.

According to the data requirements of different business functions and operation periods, databases of simulation system are designed to three basic database: simulation material database, scenario database, simulation system management database.

- Simulation meterial database is divided into basic material database and battle group database. Basic material database includes all kinds of weapon equipments performance and environment data such as geography, weather, hydrology, etc. According to different simulation requirements, grouping the basic data, forming the data of objects and equipments which taking part in the simulation experiment.

- Scenario database is used to save the scenario files which are created on the basis of battle group data.

- Database of simulation system management includes system configment information and log information. System configment information records relative config recordings such as machine, network, seat, etc. Log information records the recordings which are created in the process of system operation for latter improvement and optimization.

Except the three basic databases above-mentioned, simulation running database and simulation data warehouse are added into simulation system according to the system scale and demand of function expansion. Simulation running database records the process data in a simulation experiment. Simulation data warehouse records all process data and relative statistical information in previous simulation experiments. All the data may do favour of follow-up work such as verifying functions of C2 system, evaluating commander training effect, analysing reliability of simulation models and data mining, ect.

The exchange relationship of simulation data is showed in Figure 2.

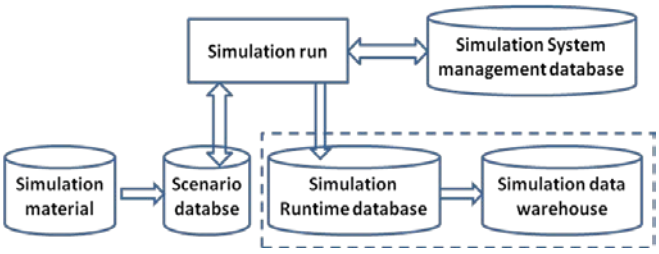


FIGURE II. SIMULATION DATA FLOW

The database used in the system can be divided into two categories: simulation material library, the library would like to set the simulation run-time library, simulation systems management library belongs to the type of operation the online transaction, the online analysis of simulation data warehouse belonging to the type of operation.

For performance reasons, when different types of database operations during database logic design requires a different logical structure for online transaction operations like database using the ER model for online analytical operations like database using the dimensional modeling.

In an online transaction class database design mainly consider the following guidelines:

- Definition of the normative;
- to ensure data consistency and integrity;
- to avoid long transaction.

During a data warehouse designed primarily consider the following guidelines:

- ensure that data can be efficiently query and analysis easy to understand;
- ensure that the data about the business object to the organization and its activities, and to answer the overall question;
- Ensure that can be sliced, diced Intuitively, the volume, the next drill, aggregation operations.

## V. INTERFACE DESIGN

Considering of the maximal compatibility and asset reuse for all existing simulation systems, the most popular HLA/RTI simulation platform is choosed in simulation system[2]. The simulators interact with each other by the way of RTI interfaces. The existing simulators which are based on

HLA/RTI platform can interact with each other directly. System interactions between the existing simulators which are not based on HLA/RTI platform could be realized by the way of adding simulation agent with minimal effort.

The system network interfaces should follow the existing national standards and military standards to realize the interconnection and interworking directly with various C2 systems, intelligence process systems, data link systems, etc.

## VI. General Simulation Application Integration Framework

Except the hierarchical design of whole system architecture, this paper refines the common characters of single simulator based on analysing the function structure for realizing common and rapid development of information simulation system. A General Simulation application integration framework is designed and implemented as an important component of general information simulation system.

Although the different functions for every simulator in information simulation system, the basic processing flow is the same which includes three modules: network module, model process module and display module. To realize rapid development and deployment of a single simulator and reduce code duplication, a General Simulation application integration framework is designed and realized which includes a set of simulation integration standards, integration framework and integration guide.

According to specific situation of simulation application, General Simulation application integration framework realizes transformation and integration of protocals, data and interfaces. The core is integration of kinds of services on simulation platform such as information sharing services, clock management services, access management services and graphics display services. Simulation components are assembled flexibly and different simulation applications are constructed rapidly through by means of integration framework and integration guide. The inner structure of Simulation application integration framework is showed in Figure 3.

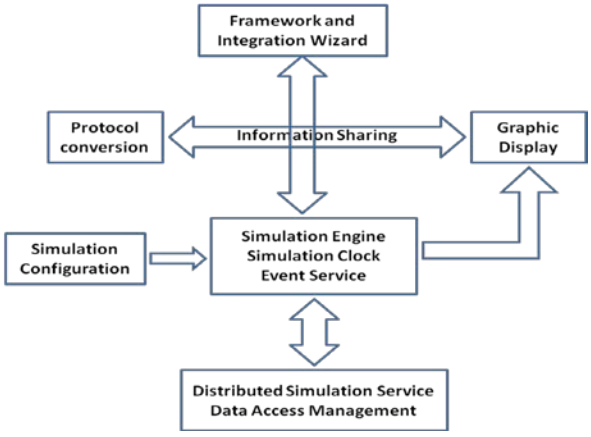


FIGURE III. GENERAL SIMULATION APPLICATION INTEGRATION FRAMEWORK INTERNAL STRUCTURE

This paper develops and realizes common services such as integration framework, integration guide, information sharing services, clock management services, access management services and graphics display services by which the module configment, load, register, information sharing and dispatch management are realized. Which application modules should be loaded and what are the information relationship between application modules are all on the basis of integration standards which can be configged flexibly by config files.

Through the General Simulation application integration framework, it is just need to modify and replace some relative business function modules and config files for simulators. When design and development staff are developping a simulator, the common services modules do not need to develop repeatly. Integration of all the function modules is just need to be realized by integration standards and configment. Developers just need to care about some design and implementation of special function modules. This increased the development efficency greatly.

## VII. Conclusion

This text analyzed the current situation and requirements of information simulation system and put forward a general information simulation system architecture and analyzed it in detail. A General Simulation application integration framework is designed and implemented which provides a feasible way for rapid development and deployment of information simulation system. The architecture is applied in practice in some intelligence process project and has achieved the anticipated target initially: high flexibility, scalability and rapid deployment of system. In next step, we will optimize this architecture and simulation integration framework.

## REFERENCES

[1] Huang Ke Di, Liu Baohong, Huang Jian, and other combat techniques Summary simulation [J] System Simulation .2008,16 (9): 1887-1895

[2] IEEE Std 1516-2000,1516.1-2000,1516.2-2000, Standard for Modeling and Simulation High Level Architecture(HLA). 2000[S]

[3] Xie bing, Wang yue, Bao guang yu,Command and control system simulation platform[j].Modern electronic engineering. 2008,4：17-20