Research on the key technologies of the end-to-end intelligent dual live data center architecture

Gang Yuan*, Shengjun Wen
State Administration for Market Regulation, Information Center, Beijing, China

*Corresponding author e-mail: 5651993@qq.com

Abstract: As a direction of the current government informatization, dual live data center can be understood as both have a high availability architecture of production system, also is a kind of disaster information system construction model. Dual live data center can not only solve the government information system of business continuity and data reliability, but also can reduce the load balance of business requests and the resource operation pressures on production part. It can improve the effect of system efficiency and the user experience. But most of current dual live data center architecture is “not real dual live”, it is only dual live in some aspects, it will not have negative impact on system external service when the specific failure occurs. In this paper, an end-to-end "full dual-activity" system architecture is proposed. By building a dual-activity system at various technical levels, two fully dual-activity data center architectures are realized. The data center constructed by this technical route can be backed up and switched intelligently. It can deal with the vast majority of failures and disasters, and provides a more reliable guarantee for the safe and smooth operation of the government information system.

1. Introduction
As an information system technology architecture that spans two data centers, dual live data center is widely used in Internet companies and some industries with high business continuity requirements. In recent years, with the reform gradually thorough, the role of information technology is also increasingly outstanding, all kinds of new technology are used in the field of government information, dual live data center architecture is also gradually used in the part of government information industry to get practical application, the architectural patterns can be real-time intelligently dual live the implementation of the business system and data disaster tolerance, which can be explained as: two data centers are running, at the same time production business be undertaking and business requests be load sharing. It can improve the utilization rate of resources, realize double improve service capability in theory, beneficial to improve the service ability of government affairs information system and the user experience, and ensure the two data centers to be real-time backup. when a data center or interruption of a business failure, another set of data center intelligently takes over the business system, which the user has no sense, it can improve the effective protection of government affairs information system of business continuity and data security, and is more suitable for the current government information positioning objectives. The current dual live data architecture can be realized in a variety of design method and related technology, in this paper, the dual live data center technology is revolves around, and the architecture is carefully discussed. By layering the technology system of dual live data center logically and analyzing the key technologies used at each level of dual live data
center, an intelligent technology architecture pattern of "end to end dual live data center" will be presented in this paper.

2. End-to-end dual live data center hierarchy

To build a end-to-end dual live data center, the first thing is ensure consistency of the two data center at the logical level, which will now be carried out in accordance with the overall architecture logical layering in each data center. As shown in figure 1, each data center is divided into five layers: storage layer, calculate layer, application layer, network layer, transport layer. The five layer should keep two live in the center of the two data consistency, so the end-to-end dual live data centre must ensure that the storage layer, calculating layer, application layer, network layer, transport layer all realize dual live, and the two data center distance is less than 30 km. In this way, when equipment failure or even single data center failure occurs in the business system, the business can be switched without awareness, and RTO=0 and RPO=0 can be achieved theoretically.

3. Technical analysis of end-to-end dual live data center

According to the logical layering of dual live data center, every aspect of the key technology used by parsing, and combined with the application of different system architecture, respectively adopted different technical route, in order to more clearly stated in the process of constructing dual live data center at all levels, the relationship between the current according to the storage layer, calculating layer, application layer, network layer, transport layer is one by one order of parsing.

3.1. The dual live design of Storage layer

Dual live storage is based on two sets of storage arrays to achieve dual live, a dual live data center storage array through dual live shared volume to achieve real-time synchronization of data, and the two data centers can simultaneously respond to the application server I/O read and write requests, to provide the upper level of completely consistent parallel access services. When the disk array of one of the data centers fails, the business system will automatically and seamlessly switch to the opposite side of storage, without interruption of business access and user awareness. The following describes the storage dual live implementation between two data centers.

In terms of device configuration, this scheme requires two dual-live storage configurations to be exactly the same, including controller model, cache size, interface and storage hard disk configuration for establishing dual-live space. In terms of networking, FC network is recommended for the connection between storage and server; 10GE link is recommended for the connection between dual-live data centers; the SAN network for the server accesses and stores is independent from the 10
gigabit network that synchronizes data; 10GE Ethernet switch is deployed in the data center, and interconnection is realized through optical fiber link.

![Network Connection of Dual Live Storage](image)

**Figure 2.** The network connection of dual live storage

As shown in the figure, the storage equipment volume of the two data centers is configured into a dual live mirror pair. Data synchronization is carried out through the optical fiber link in the middle to ensure the complete consistency of data at both ends. At the same time, virtual volume technology and dual live mirror technology are adopted to form a logical virtual volume. For the server, dual live mirror pair means that it can be accessed through multiple paths, and the form is the same data volume. In this way, the server can read and write the two volumes in the dual live mirror pair at the same time. And the two storage systems that make up the dual live mirror system are HA modes of each other. When one storage array fails, the other storage array can directly take over the service. The whole switching process takes seconds to realize the zero loss of data and zero stop of business. Both RTO and RPO are close to zero. In this scheme, as long as the link delay is less than a certain range, the storage dual activation mechanism between different data centers can be realized.

![Architecture of Dual Live Storage](image)

**Figure 3.** The architecture of dual live storage

3.2 The dual live design of computing layer

The dual live of the computing layer is mainly realized by deploying the computing cluster mode that spans the dual live data center. Through the function of the cluster, the switch of services can be completed quickly under various failure scenarios to provide users with zero interruption and zero loss of business access. But now more commonly used virtualization clustering technologies exist the following problems, because on one physical machine to deploy more virtual machine, when the physical machine failure, according to the virtual machine clustering, the virtual machine will be resumed in other physical machine to migration, this process will result in business which is a short interruption. This was the result of HA business interruption problem, to achieve the function of calculating layer dual live, such problem should be avoided, so the main consideration of the calculated layer dual live design is to solve the problem of virtualization HA cluster, otherwise it will not be achieved in the true sense of computing layer dual live system. Therefore, in the design, as long as the same services are deployed in the virtual machines of two data centers and load balancing equipment, the existing requirements can be met. When one physical machine fails, the services on the
virtual machines of another data center can take over the business in real time and realize the perception-free switching of the business. Recommended in the design, it can be considered that the two data centers can virtualize computing resources, establish its virtualization cluster. Two data centers connect to network layer through at the same time, and the dual live storage platform will be virtualized to provide Shared storage space mapping to cluster all of the host machine, so you can ensure that the virtual machine expanding across the data center migration will make whole virtual machine cluster have sufficient flexibility and reliability of this design method, which can be implemented to ensure deployment related business system in the center of the dual live data not be interrupted by using the load balance of the two data centers of the allocation of resources. This not only solves the problem of computing layer dual live virtual machine cluster HA, but also improves the utilization of resources and operational efficiency, with better reliability and flexibility.

3.3 The dual live design of application layer

For the application layer, according to the type of application architecture, it can be divided into B/S architecture and C/S architecture, and the corresponding application dual live design is also different. However, no matter B/S and C/S architecture, to achieve dual live application, the underlying database must be guaranteed to be dual live first. Database design of dual live mainly by building database cluster method, as shown by building across two data centers of A/A dual live database cluster system, provide the same service at the same time to the upper, and can realize seamless switching database failure, improve the performance of the application system, the plan calls for two data centers to deploy the same database, and database synchronization with cross data center function, maintain two data center data consistency. It is currently the most widely used and most mature by Oracle RAC cluster system to implement the database, Oracle RAC is based on Shared storage, through Shared storage resources, the realization of each node parallel access database related files, when a single node failure, database by Oracle RAC function can guarantee that the business can automatically switch to the normal nodes, so as to ensure the normal order of the database system is available. In the case of across two different data center, to achieve dual live database, the proposal USES Oracle Extended RAC cluster technology, the technology can be applied to multiple data centers, realize the extension of the resource, and use of multiple data center storage and server resources, improve the availability of the data center system and maintainable, and cooperate with the listener of Oracle database technology, which can realize the client business between dual live in the center of the data access and load balancing. If one node fails, RAC can automatically switch connections to one or more other nodes through monitoring processes in the background, allowing seamless handover of applications and high availability protection of database instances.

**Figure.4 The dual live architecture of database**

For the application of B/S architecture, a Web server is usually designed to correspond to an application server cluster, as shown in the web level: at design time in more than two data center deployment of A web server, web server not formed between clusters, mainly through the selection of load balancing is applied to implement resource, will each inside the data center all the web server of A resource pool, namely data center A and B have A web server resource pool. At the APP level:
deploy multiple application servers in two data centers establish a dual live cluster across two data centers. At the DB level: similar to the design of APP, set up a dual live database cluster across two data centers to provide services for upper applications.

![Figure 5. The dual live architecture of B/S application](image)

The application dual live design of C/S architecture can be divided into single data center deployment and cross-data center deployment according to the application deployment mode, and the corresponding application layer dual live implementation mechanism is also different. In the single data center deployment mode, that is to say, access to the main path can only be published by one data center, so the host of an application can only be deployed in the single data center to run, but the current deployment mode across the data center application cluster can automatically switch application failure to another data center. Therefore suggestions of deployment characteristic of this kind of application, will be deployed to the application of the different two data center operation, can automatically when a single data center application problems in another data center application service, and through the load balancing strategy implementation request forwarded to run normal application on the host data center. In the way of the cross data center deployment, application service can run in the center of the two data at the same time external use different IP addresses, configure load balancing strategy, each client configure multiple server IP or configuration corresponding server IP, only to different customer request load balance to the two data centers, when an application failure, it can modify the client corresponding server IP, normal application server sends a request to work, to ensure the continuity of the application system.

3.4 The dual live design of network layer

Dual live data centers are located at different locations and far away from each other. In order to realize the dual live mechanism of two different data centers, it is necessary to ensure the dual live mechanism at the network level. Therefore, the distance between the two data centers is correlated. In general, to build a dual live data center system, minimize network link delay and attenuation caused by distance, in principle, to ensure that the link distance between two data centers is less than 30 km, two dual live in design data center network data transmission link and heartbeat link separation was adopted to design the principle, configuration independent physical interconnection link respectively, achieve business network and the cluster heartbeat separation, and USES the FC link between dual live data center data real-time synchronization, layer 2 Ethernet network was adopted to realize the double heartbeat and host cluster synchronization interconnections between live data center link communication. In the design of network dual mode, the design and working mode of network dual mode are different according to the types of application architectures. The following are different
network dual mode for B/S architecture application and C/S architecture application: For the application of B/S architecture for Web applications, access to foreign by domain name, a domain name corresponding to the two data centers the IP address of the business, the deployment respectively in the two data centers, B/S application architecture usually adopt a Web App - DB three layer structure, in the network design, the Web - the App layer two data centers gateway to independent each other, and in different segments, each release routing, network segment in the DB layer two data centers to achieve interconnection on the second floor, in the same network segment, each data center deployment double gateway, and only to the database host routing released within the data center, And host routing is not published to the wan. In terms of load balancing, B/S architecture can achieve load balancing of two data centers through global load balancing (GLSB). If the business volume is low, simple access load balancing can be achieved between the two data centers through DNS. B/S architecture network dual work is shown in the figure 6.

![Figure 6](image6.png)

**Figure 6.** The dual live network architecture of B/S application

For C/S architecture applications, IP access is provided externally without global load balancing (GSLB) devices. App layer needs two layers of interconnection between the two data centers, in the same network segment, each site deployment of centralized gateway or dual live gateway, the centralized gateway USES the main and secondary mode, respectively published host routing, dual live gateway will be based on the virtual machine location of the nearest release host routing. The two data centers at the DB layer need to be connected to each other at the same network segment. The two data centers need to deploy dual-live gateways, and each dual-live gateway only publishes the host routing of the database within the data center. The host routing will not be released to the wan, and the dual-live network of C/S architecture is shown in the figure 7.

![Figure 7](image7.png)

**Figure 7.** The dual live network architecture of C/S application

3.5 The dual live design of transmission layer

The dual live of transmission layer is mainly realized by wave division equipment., two data centers to deploy the same wavelength division equipment, required by the two wavelength division equipment connect two time delay is less than 0.1 us data center link, and can automatically choose the optimal transmission path selection, at the same time in order to improve equipment reliability, suggested that each data center configuration redundancy wavelength division equipment, and each wavelength division equipment redundancy interface card.
4. Double design of cloud management platform

With the application and development of cloud computing technology, through the cloud computing technology can realize dual live data center architecture, through the cloud management platform to provide the management of the two data centers, the building covers two data centers "cloud", through the unified account and permission system, unified service portal and the centralized control, each data center deployment of cloud management platform control agent alone, center cloud management platform by regulating agents to manipulate the data center resources, the user can use different data center resources at the same time, with different ways of application deployment and disaster preparedness strategies, so as to realize dual live center of cloud unified deployment.

5. Conclusion

This paper describes the architecture and construction mode of dual live data center from five levels: storage layer, computing layer, application layer, network layer and transmission layer, analyzes the key technologies used at each level, and proposes a construction method to realize end-to-end dual live data center. The dual livedata center system built according to the method proposed in this paper can theoretically improve the business continuity of government affairs information system to a large extent, deal with common faults, hidden dangers and disasters, and form a reliable guarantee for existing business applications and key data. But end-to-end dual live data center architecture is a complex and interconnected whole, any link to appear problem, can lead to cannot achieve end-to-end dual live completely, dual live data center also has high investment cost and operational difficulty big, the technical implementation and the demand is higher and the route dependence problems, with the gradually popularization of cloud computing in the field of government information is used, is proposed in this paper the end with cloud computing technology to build an end-to-end double living data center will be double future data center is an important direction of the development of the technology, Cloud computing technology can not only build an end-to-end dual-live data center system more easily and efficiently, but also build an end-to-end dual-live data center with stronger reliability and higher fault tolerance, which has a broader application prospect in the current government informatization field.

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