

Research on Actwill Data Migration Services Based on SDN

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Abstract: *SDN (Software Defined Network) is an emerging network design concept that breaks the architecture of traditional networks and introduces a new network architecture featuring centralized software management, programmability, and separation of control and forwarding planes. SDN represents a technological innovation and a new network philosophy, addressing the incompatibility and complex forwarding issues of traditional networks. At the same time, a variety of technologies have been derived from this technology. This paper presents research and analysis conclusions on data migration service technologies based on SDN.*

Keywords: SDN; AWS; Disaster recovery; Network model; Data migration; Application cluster.

1. INTRODUCTION

The advent of the cloud computing era marks the rapid development of the information age, under which network innovation is indispensable. While enterprises use cloud services, they face business changes and network optimization, making secure and efficient data migration a challenge. Most enterprise businesses are built on the cloud and run in real time. Virtualization technology integrates various network resources, and large volumes of data flow within virtualized servers. During data migration, it is necessary to ensure the integrity of the business systems and data being migrated, while minimizing the impact on normal business operations. Therefore, introducing the SDN design concept to standardize data control ensures that data is minimally affected by external factors during migration. Li et al. (2025) enhanced intelligent recruitment by integrating Generative Pretrained Transformer with hierarchical graph neural networks to improve resume-job matching[1]. In the financial sector, Su et al. (2025) developed the WaveLST-Trans model for anomaly detection and early risk warning in financial time series[2], while Zhang, Li, and Li (2025) leveraged deep learning for carbon market price forecasting and risk evaluation in green finance[3]. For recommendation systems, Wang (2025) proposed a joint training method for propensity and prediction models to handle data missing not at random[4]. Ding and Wu (2024) provided a systematic review of self-supervised learning applications in biomedical signal processing for ECG and PPG data[5]. The development and deployment of large language models were facilitated by Zhang (2025) through the InfraMLForge developer tooling[6]. In advertising and content creation, Hu (2025) introduced GenPlayAds, a generative model for procedural playable 3D ad creation[7], and Li, Wang, and Lin (2025) designed a graph neural network-enhanced sequential recommendation method for cross-platform ad campaigns[8]. Generative modeling was also applied to urban design by Xu (2025) with CivicMorph for public space form development[9]. Tu (2025) addressed smart regression detection with ProtoMind, utilizing modeling-driven neural architecture search[10]. For industrial applications, Xie and Liu (2025) optimized monitoring systems with InspectX, enabling real-time analysis via OpenCV and WebSocket[11]. Zhu (2025) focused on improving system reliability with REACTOR, a framework for automated causal tracking[12], and Zhang (2025) proposed AdOptimizer, a self-supervised framework for efficient ad delivery in low-resource markets[13]. Hu (2025) also contributed to 3D authoring with a low-cost, guided diffusion pipeline[14]. Tan et al. (2024) employed transfer learning in densely connected convolutional networks for highly reliable fault diagnosis[15]. In strategy and marketing, Zhuang (2025) explored the evolutionary logic and theoretical construction of real estate marketing strategies under digital transformation[16]. Han and Dou (2025) improved user recommendation by integrating a hierarchical graph attention network with a multimodal knowledge graph[17]. Finally, Yang (2025) applied the Prompt-BioMRC model for identification tasks in intelligent consultation systems[18].

2. INTRODUCTION TO THE SDN NETWORK MODEL

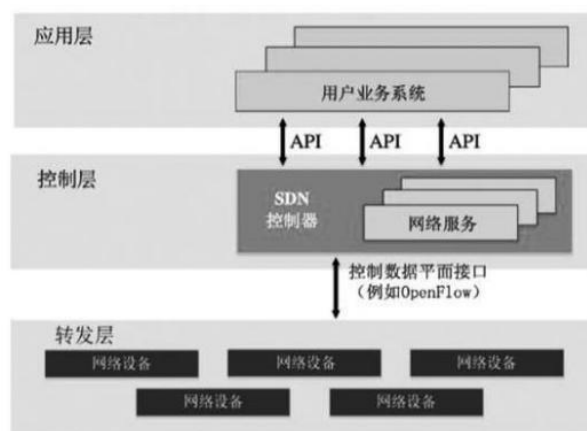
In traditional networks, a layered structure is adopted, with different types of devices placed at each layer. Layers rely on protocols for interconnection, which are cumbersome and difficult to implement, resulting in high operational complexity. Data forwarding mainly depends on routing tables generated by routers for path calculation and selection, leading to insufficient flexibility in adjusting data flows. Moreover, as enterprise

businesses continue to grow, device deployment and upgrades become inevitable. Once a device fails, business operations are affected, significantly reducing work efficiency. At the same time, network devices produced by different vendors have varying functionalities, and compatibility between devices is a major issue. Few external application services can operate within a single working environment, making management difficult.

SDN abandons the traditional network architecture and introduces three planes—application, control, and data—unified by a management platform, thereby simplifying the overall network environment to a certain extent. The application plane interacts with the control plane via northbound interfaces, abstracting applications so they can directly control the network, while the data plane interacts with the control plane via southbound interfaces to govern forwarding behavior, provide device-performance queries, and perform statistics and notifications. SDN's three core characteristics are separation of forwarding and control, centralized control, and open interfaces: network elements are controlled, flow tables are generated through protocol computation, the controller centrally manages and distributes these tables, and, after device configuration, open interfaces enable management of the entire network. The most critical step in SDN is decoupling the control and data planes; the OpenFlow architecture converts all data into flow tables for lookup and forwarding. Leveraging this advantage, data can travel along optimal paths to destination devices, and, in theory, can be migrated in flow-table form, ensuring both data integrity and transmission efficiency.

At present, the control plane is still immature. The initial plan is to transform data into a generic tagged data stream, yet how to design such streams for migration between specific pairs of devices remains an open question. We abstract network devices into a universal forwarding model so equipment from different vendors can coexist, and we tag data so that identical data types are distributed along predetermined paths to corresponding devices, improving migration efficiency. Therefore, the control plane under development is designed to direct flow tables, enabling targeted data forwarding while also using virtualization to process and migrate data. The following sections detail the concrete implementation of data migration and the design workflow for abstracting migration data via clustered applications.

ONF defines the basic SDN architecture



3. MAINSTREAM DATA MIGRATION TECHNOLOGIES

3.1 Introduction to Data Migration

An enterprise's core resource is data; behind vast amounts of data lie hidden commercial values. Data typically follows a lifecycle—from birth, growth, and use to eventual deletion. Data resides on physical storage devices; even when cloud platforms employ virtual storage, the data ultimately ends up indirectly on physical media or via virtual-disk mapping, so it cannot function without the support of various devices [4]. The network equipment we use usually has a warranty period; over long-term operation its physical performance degrades, impeding data transmission. In a sense, data is entirely dependent on its host devices. Once a device can no longer meet the data's operating requirements, replacement becomes necessary—this is why data migration is required. Choosing a new host device alters the data's operating environment, raising issues of performance and compatibility; equipment that ran flawlessly on the previous host may encounter all kinds of problems on the new one. For enterprise-grade migrations, one must also consider data security, data availability, and the downtime incurred during migration.

Therefore, before migrating, backups are essential; if anomalies occur, immediate rollback and service restart are required. This is a problem that can never be fully solved, and data migration always carries an element of luck.

3.2 Data Migration Methods

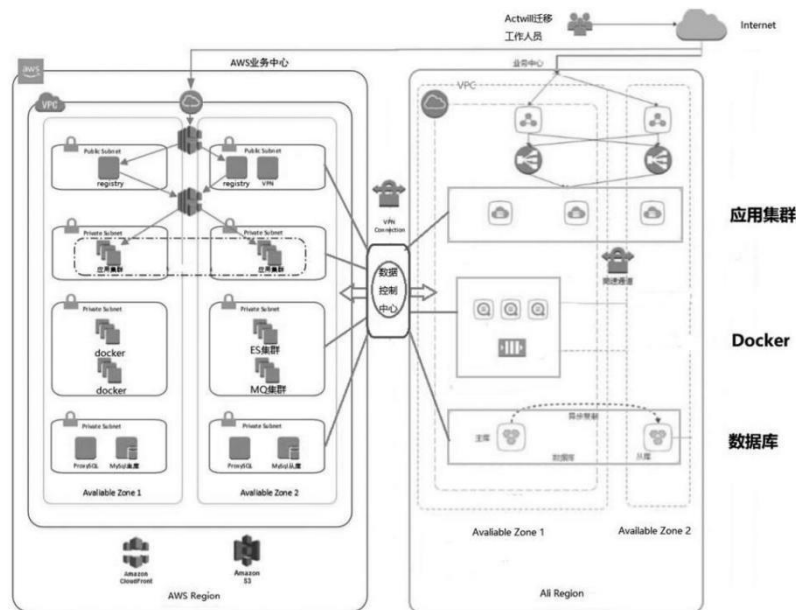
Data migration is indispensable for enterprises. Current mainstream techniques fall into four categories: application migration, volume-management migration, network migration, and storage-layer migration. Application migration includes database migration, file-system migration, and virtual-machine migration. All three usually require an intermediate software tool: when the source and target support different file formats or types, conversion to a mutually compatible format is needed before migration can proceed, often consuming considerable time. Volume-management migration aggregates or splits SAN raw devices for upper-layer applications, using volume-management software to manage data and leveraging its built-in mirroring for migration. Network migration virtualizes devices, transmits data through gateways, then uses mirroring to copy it to the target storage while modifying related configuration files. Storage-layer migration maps the source storage device to the target, exporting data from source to target via read/write operations, but generally requires both storage objects to come from the same platform product, limiting its applicability.

4. ACTWILL MIGRATION SOLUTION DESIGN PROCESS

4.1 Migration Basic Architecture

From the preceding discussion, the SDN layer must address the design of the control plane; a pressing issue is how to centrally manage data and decompose it into generic, tagged flows. From a data-migration perspective, the design classifies devices by type while enabling data to be delivered directly rather than via relays. The Actwill migration plan follows the AWS data-migration architecture: establish a site region, deploy a Virtual Private Cloud (VPC) within it—i.e., build a private cloud on top of the public cloud platform [5]. Inside the VPC, the structure is split into public and private subnets using CIDR blocks; the public subnet hosts VPN access, registration services, etc., while the private subnet hosts application clusters, including Docker containers and various instance services, grouped by service type into the same private subnet. Typically, a single VPC contains multiple Availability Zones (AZs) to host multiple services and provide disaster recovery; applications such as databases and management services are deployed at both sites. If one site fails, the other automatically takes over to keep services running.

This migration project involves moving data from Alibaba Cloud to AWS. A VPN connects the two data centers, with a load balancer placed at the connection point to achieve load balancing; the nearest site region is selected as the service-response zone so that requests and data arrive as quickly as possible. The key is to establish an automated data-control application cluster that can classify in real time all Docker containers and instance services slated for migration, extract their data, and place it in new subnets according to defined logic. While operating, the data-control center gathers resource information, unifies and abstracts it, and then, guided by tags in the information flow, transfers it to the appropriate subnet environments. The instances being migrated run Linux; each carries multiple attributes—instance ID, image ID, and instance type family. When developing the data-control cluster application, data flows are compiled according to the distribution rules of these attributes. During hierarchical migration, instances with similar data flows are moved to a data-control cluster application in another AZ; the flows are then parsed and restored to the original instance attributes. Once the configuration for the target AZ is set, migration from one AZ to another is achieved without the traditional export-import cycle. During development, the cluster application must also track migration timestamps; mismatched attributes during transfer can cause errors, so achieving flawless migration remains challenging, as data may still depend on the original resource environment.

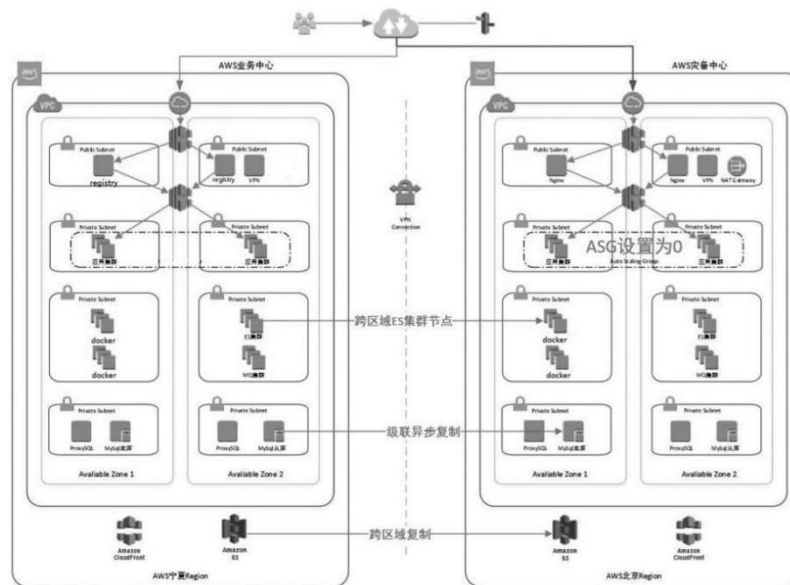


4.2 Migration Plan Implementation

Classify by business tier, perform tier-by-tier cutover, configure relevant network files at the application level, manually switch DNS services, rebuild the image repository so that images from Alibaba Cloud can be imported into the AWS registry, and deploy across three AZs to ensure application-layer services remain operational after migration [6]. For the accumulated MQ message-queue service cluster and ES cluster in the middle, perform on/off operations, redeploy ES instance nodes on AWS EC2, and after data validation, gradually decommission the original Alibaba Cloud nodes while rebuilding the MQ cluster. For database migration, use the DTS data-transfer service to extract, transform, and merge data into the target; after the database cutover, rebuild read replicas on AWS EC2. Object storage will adopt a CDN network acceleration model, collecting node connectivity and load information and directing traffic to the nearest node to improve site stability; during migration, the original CDN will be replaced by a newly built CDN. After completing this series of deployments, conduct testing and add a rollback plan—if any migration error occurs, roll back to the original infrastructure. The entire migration uses a VPN private network and a dedicated data center for data transfer, ensuring transmission security.

4.3 Synchronous Migration and Disaster Recovery

AWS has two Regions in China: Ningxia and Beijing. To ensure post-migration service stability, these two Regions will be leveraged for disaster recovery [7]. The two VPCs are interconnected via network links and VPN, and all business resources in the AZs are replicated one-to-one so that every workload has two access regions, increasing reliability and minimizing latency. In case of data loss causing service interruption, the two AZs will feed back to each other and replicate data, immediately activating the other Region to keep all services running. For different application clusters, cross-region node replication will be used: first pre-replicate the resource pool, configure its storage services, then replicate the application clusters across nodes. Database replication uses cascaded asynchronous replication: the master records changes in a binary log, and the slave detects the log; once changes occur, events are triggered to read the log and replicate. Storage facilities can rely on AWS services for real-time deployment, achieving cross-region replication.



5. CONCLUSION

The implementation of the developed data-application control center depends on the evolution of the SDN control plane; in multi-tier data migration, complete data separation cannot be achieved, and during data abstraction, label-style data conflicts may cause unpredictable transmission errors. During the migration process, mainstream migrate the technology and use AWS private cloud as the core for data migration, perform backups and prepare rollback plans, minimizing potential business losses during the entire migration process. Currently, the business and data to be migrated will be integrated and processed, employing multi-layered technologies to carry out the overall business migration.

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