

# Empowering Multimedia Streaming The Cloud Approach



# Contents

|  |    |
|--|----|
| 01 Introduction to Multimedia                                | 03 |
| 02 Paradigm Shift  | 04 |
| 03 Video Surveillance  | 05 |
| 3.1 Traditional Solutions and Challenges                     | 05 |
| 3.2 Market Trends and Alibaba Cloud Multimedia Solutions     | 05 |
| 3.3 Solution 1: Classic Solution                             | 05 |
| 3.4 Solution 2: Video Data Solution                          | 07 |
| 04 Video on Demand (VOD)                                     | 09 |
| 4.1 Traditional Solutions and Challenges                     | 09 |
| 4.2 Market Trends and Alibaba Cloud Multimedia Solutions     | 09 |
| 4.3 Solution 1: Classic Solution                             | 09 |
| 4.4 Solution 2: Platform-based VOD Solution                  | 11 |
| 05 Live Video Broadcast                                      | 13 |
| 5.1 Traditional Solutions and Challenges                     | 13 |
| 5.2 Market Trends and Alibaba Cloud Multimedia Solutions     | 13 |
| 5.3 Solution 1: Classic Solution                             | 13 |
| 5.4 Solution 2: OSS-based RTMP Access Solution               | 15 |
| 5.5 Solution 3: Platform-based Live Video Broadcast Solution | 16 |
| 5.6 Solution 4: International Live Video Broadcast Solution  | 17 |
| 06 Conclusion  | 19 |

# 01 Introduction to Multimedia

Multimedia adds a creative and captivating dimension to both information sharing and our daily lives. It's no surprise that the use and absorption of multimedia is exploding.

Multimedia incorporates multiple categories of content including text, images, audio, video, animation, and other information that can be processed and shared in a digital format.

The vast majority of web pages host multimedia in one form or the other, known also as web-based multimedia. Web-based multimedia pages are highly interactive and display desired data using hyperlinks.

Initially, web-based multimedia was restrained due to the limitations of both computers and Internet performance. Advances in broadband connection speeds have led to rapid growth and development of web-based multimedia. Today, multimedia is indispensable for every online business.

This whitepaper introduces readers to the relationship between cloud computing and the multimedia industry. The paper summarizes popular business scenarios and offers guidance based on Alibaba Cloud solutions and best practices. It serves as a quick reference guide for IT system managers and technology leaders on how they can leverage Alibaba Cloud products to extract maximum value from their multimedia portfolio.

## 02 Paradigm Shift

The evolution and constant development of the Internet has led to a boom in the multimedia industry. Movies, gaming and other related media categories are moving to the cloud for improved usability and accessibility. This is especially true for services such as video surveillance, video-on-demand (VOD), and live video broadcasts. The [video surveillance market](#) is expected to grow to \$71.28 USD billion in value by 2022, at an estimated CAGR (Compound Annual Growth Rate) of 16.56 percent. The [VOD market](#) is predicted to grow from \$25.30 billion as of 2014 to \$61.40 billion in 2019, at 19.4 percent CAGR. The global [video streaming market](#) is estimated to grow from \$30.29 billion in 2016 to \$70.05 billion by 2021, at 18.3 percent CAGR.

A significant amount of computation is required to cater to millions of user requests to access multimedia files at the same time. [Each month, Facebook hosts more than 30 billion pieces of content while Twitter users post an average of 55 million tweets daily, including web links, videos, and pictures.](#)

Traditional solutions are not able to keep pace with such rapid demand. This has created an urgent need for highly efficient and low-cost technologies and has made the use of cloud technology an inevitable trend in the multimedia industry.

Using massive storage, elastically scalable computing, extensive network capabilities, and lower costs offered by cloud computing, enterprises can now build cheaper platforms that provide enhanced availability and elasticity. In a cloud-based environment, users can process and store their multimedia application data in a distributed manner. As the volume of multimedia content grows exponentially, the ever-expanding digital media universe requires a new and advanced approach to content delivery. Content Delivery Networks (CDN) deliver web pages and other multimedia content through dedicated network links, caching servers, and increased use of peer-to-peer technologies to optimize network usage.

The multimedia industry is undergoing a paradigm shift, moving away from traditional broadcasting models and platforms towards the cloud. This is due to a dire need for performance during peak workloads, quick scalability without resource wastage, proper provisioning and management, high reliability and backups, and overall value for money. Cloud computing offers various opportunities for media companies to enhance their competitive advantage by bringing content to multichannel, three-screen (Television, Internet, and Mobile) and fourth-screen (advertising and media space) markets faster than ever before while also potentially reducing costs.

Alibaba Cloud Multimedia Solutions offer a suite of powerful cloud-based services to create, implement, and deliver digital media content. These services are cost-effective, scalable, and secure. They provide massive storage capacity and efficient delivery of video, audio, and other digital content on the cloud. The subsequent section explores Alibaba Cloud services for video surveillance, video on demand and live video broadcast - three of the most popular industry scenarios.

## 03 Video Surveillance

### 3.1 Traditional Solutions and Challenges

Video surveillance is an important part of security systems and provides the physical foundation for key departments or sites to carry out real-time monitoring activities. Traditional video surveillance solutions are mostly built on LAN-based networks, servers, VCRs, and cameras. These highly complex solutions come with high construction and maintenance costs. Traditional infrastructures are expensive and take time to plan, implement, and maintain.

### 3.2 Market Trends and Alibaba Cloud Multimedia Solutions

Cloud-based video surveillance solutions are gaining popularity among small and medium-sized enterprises due to their high-quality, reliability, security, and low cost of deployment and maintenance.

A high-resolution video surveillance management system requires huge amounts of storage and network bandwidth. With IP cameras (IPCs) and cloud computing becoming increasingly popular, video surveillance solutions based on cloud computing have significantly lowered construction and maintenance costs for industry brands and platform providers. In the past year, the world market for video surveillance equipment has grown by more than 7 percent, and storage configured for video surveillance is gaining more industry attention. [RAW capacity for SAN, NAS, and DAS storage used for video surveillance increases by 40 percent each year \(CAGR 2014-19\)](#). This has led to a huge demand for cloud video surveillance. Based on its massive cloud storage capabilities, elastic computing, rich bandwidth resources, and sophisticated security control mechanisms, Alibaba Cloud Multimedia Solutions provides tailored solutions for the video surveillance industry.

### 3.3 Solution 1: Classic Solution

#### 3.3.1 Overview and Architecture Diagram

This solution divides a video surveillance system into three modules: **Video storage module** uses Server Load Balancer and an ECS cluster to receive video streams uploaded by IPCs. Server Load Balancer supports uplink bandwidth in the GB range. The uploaded video streams are distributed by the Server Load Balancer to ECS instances for segmented storage. Video segments are stored on Object Storage Service (OSS), and the segment index is stored in an RDS database. **Video viewing module** creates an external web service that equips user terminals with real-time viewing capabilities. This module's Server Load Balancer instance receives access requests from user terminals and submits them to web servers (ECS instances) for processing. The web server performs user and device verification, and then

retrieves the video index database and searches the video index. Finally, it retrieves the required video from OSS and returns it to the terminal. **System management module** is responsible for user information management, device management, user verification, and other system management-related services.

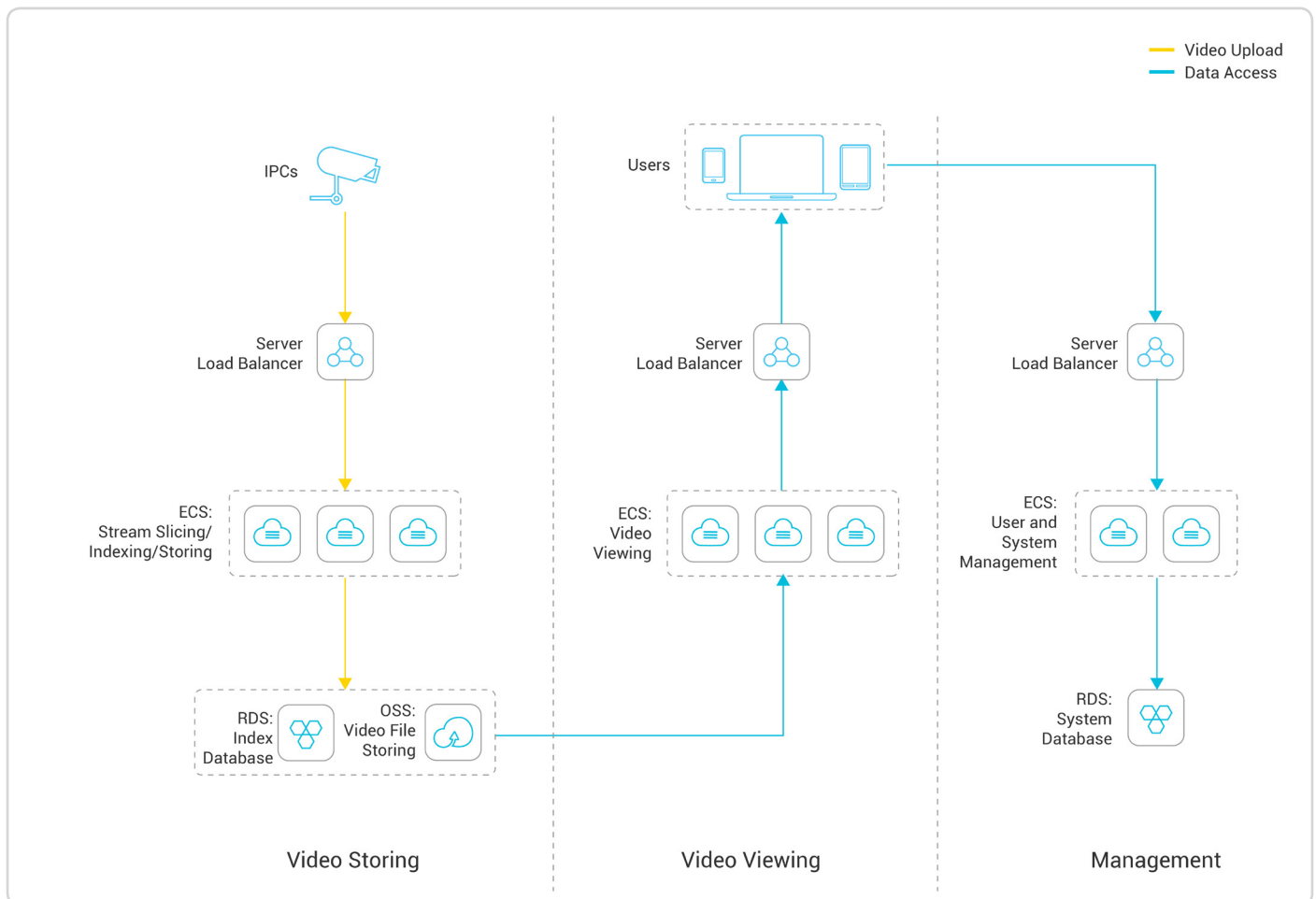


Diagram 1: Video Surveillance - Classic Solution

### 3.3.2 Key Cloud Products Involved






In the video storage module, the Server Load Balancer instance serves as the video stream upload portal, providing ultra-high bandwidth. In the video viewing and system management modules, Server Load Balancer instances act as web server load balancers to provide high-availability web user architecture.

ECS instances provide computing capabilities for the entire system, which are used for video stream segmentation and as web servers to respond to and process client requests.

OSS provides massive, low-cost data object storage capabilities to support PB-level (PetaByte) data storage scenarios and fully satisfy the needs of video surveillance services for storage resources. Also, it ensures very strong data reliability through triplicate storage.

RDS is primarily used to store the video segment index and system data. Currently, a single RDS instance can store up to 2TB of data. If the business data volume exceeds this limit, Alibaba Cloud offers an RDS distributed solution (Peta-Data) and Table Store.

### 3.3.3 Solution Highlights

-  Significantly reduces costs with free uplink bandwidth
-  Architecture free of Single-Point-Of-Failure (SPOF)
-  High SLA assurance, effectively ensuring availability of entire system
-  Elastically scalable system at any time
-  Maximizes data security of content stored in OSS with flexible configuration authentication management

## 3.4 Solution 2: Direct Video Data Solution

### 3.4.1 Overview and Architecture Diagram

Unlike the Classic Solution, this solution uses OSS to provide direct video stream storage capabilities. The surveillance video stream is directly taken from the IPCs and written to OSS, removing the need for a video segmentation cluster. In this solution, the IPCs must keep the Alibaba Cloud account access key (AK) for direct access to OSS. Multiple access keys can be generated and used accordingly. However, this creates a potential security risk. Therefore, this solution uses STS to provide temporary tokens for IPCs. With a temporary token, an IPC can still directly access OSS, but there is no risk of AK leakage. This solution also reduces the overall system cost.

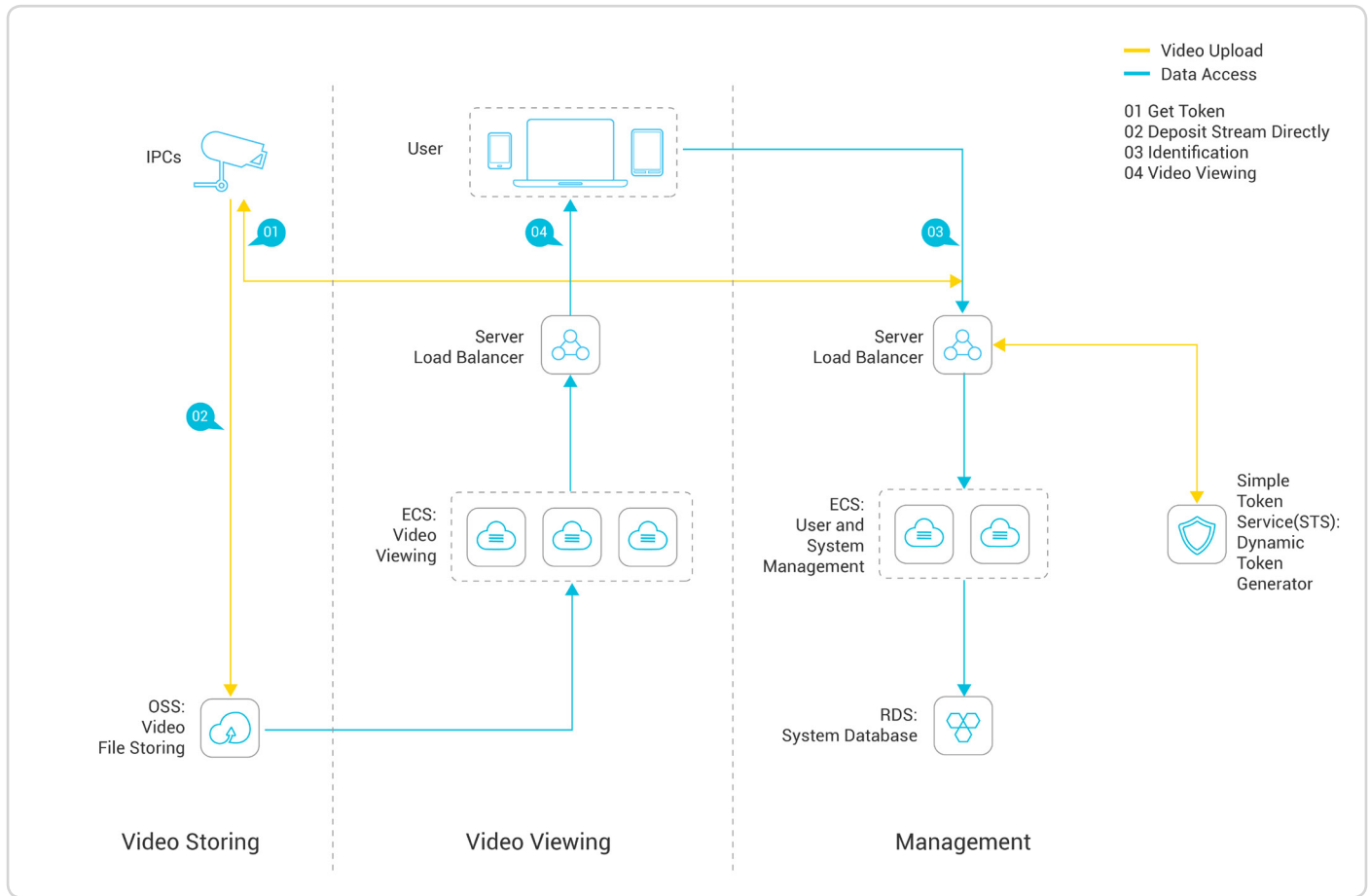





Diagram 2: Video Surveillance - Direct Video Data Solution

### 3.4.2 Key Cloud Products Involved

OSS provides Append Object for data or media content to be appended to the existing file and no loss of stored data. This allows the video stream to be stored directly. The uploaded content can be accessed even when this object (file) is not completely written, allowing for file storage and video playback within seconds.

STS integrates the user's system permission verification function and provides temporary tokens to verified devices. This allows users to effectively control device permissions.

### 3.4.3 Solution Highlights

-  Reduces overall construction cost with direct storage method that removes the need to purchase ECS and Server Load Balancer instances to construct the segmentation cluster
-  Reduces development costs as using an SDK, IPCs can directly write data to storage without the need for segmentation, caching, and other processes
-  Enhances system security through temporary tokens provided by STS for accessing video storage



## 04 Video on Demand (VOD)

### 4.1 Traditional Solutions and Challenges

VOD is a service that facilitates immediate downloading and viewing of videos either in real-time or for future consumption. It is a very common business scenario in the multimedia industry. It requires strong infrastructure resources to handle large periodic business load fluctuations. Traditional solutions face challenges such as delays in simultaneous video uploading, processing, streaming, playing, and uncontrollable peak traffic caused by burst services. The complexities of the network environment often result in a poor user experience. Therefore, it is essential to create a fast, elastic, and powerful architecture for VOD services.

### 4.2 Market Trends and Alibaba Cloud Multimedia Solutions

VOD has become a crucial component of the multimedia industry with the revolution of mobile technology and "on-demand" becoming the new normal. [The global VOD market is expected to grow to \\$100 USD billion by 2021](#). This kind of growth poses great demands on network efficiency, video processing, and high-service quality, and can obviously not be accommodated with existing infrastructure. This is where the cloud fills the gap with faster performance, near-instant scalability, and reduced deployment and maintenance costs.

Alibaba Cloud provides tailored VOD solutions. With powerful CDN and storage infrastructure capabilities, these solutions enable enterprises to support millions of concurrent viewers while ensuring an enriching user experience.

### 4.3 Solution 1: Classic Solution

#### 4.3.1 Overview and Architecture Diagram

This solution divides the VOD platform into three modules: video uploading, video broadcasting, and system management. It uses a Server Load Balancer and ECS architecture to construct a high-availability VOD web service. In the **video uploading module**, video files are uploaded to a web page of the platform and stored on OSS, which provides PB-level video file storage capabilities. The segment index is stored in an RDS database. Moreover, OSS can be directly integrated with media transcoding system (MTS) and CDN to provide video file transcoding and delivery capabilities. To adapt to different business loads, this architecture possesses elastic scaling capabilities for each module to expand without any limits. OSS and CDN usage is billed according to actual usage, significantly reducing costs. The **video broadcasting module** creates an external web service that equips user terminals with real-time viewing capabilities. This module's Server Load Balancer instance receives access requests from user terminals and submits them to web servers (ECS instances) for processing. The web server performs user and device verification. Next, it retrieves the video

index database and searches the video index. Lastly, it retrieves the needed video from OSS and returns it to the terminal. The **system management module** is responsible for user information management, device management, user verification and other system management-related services.

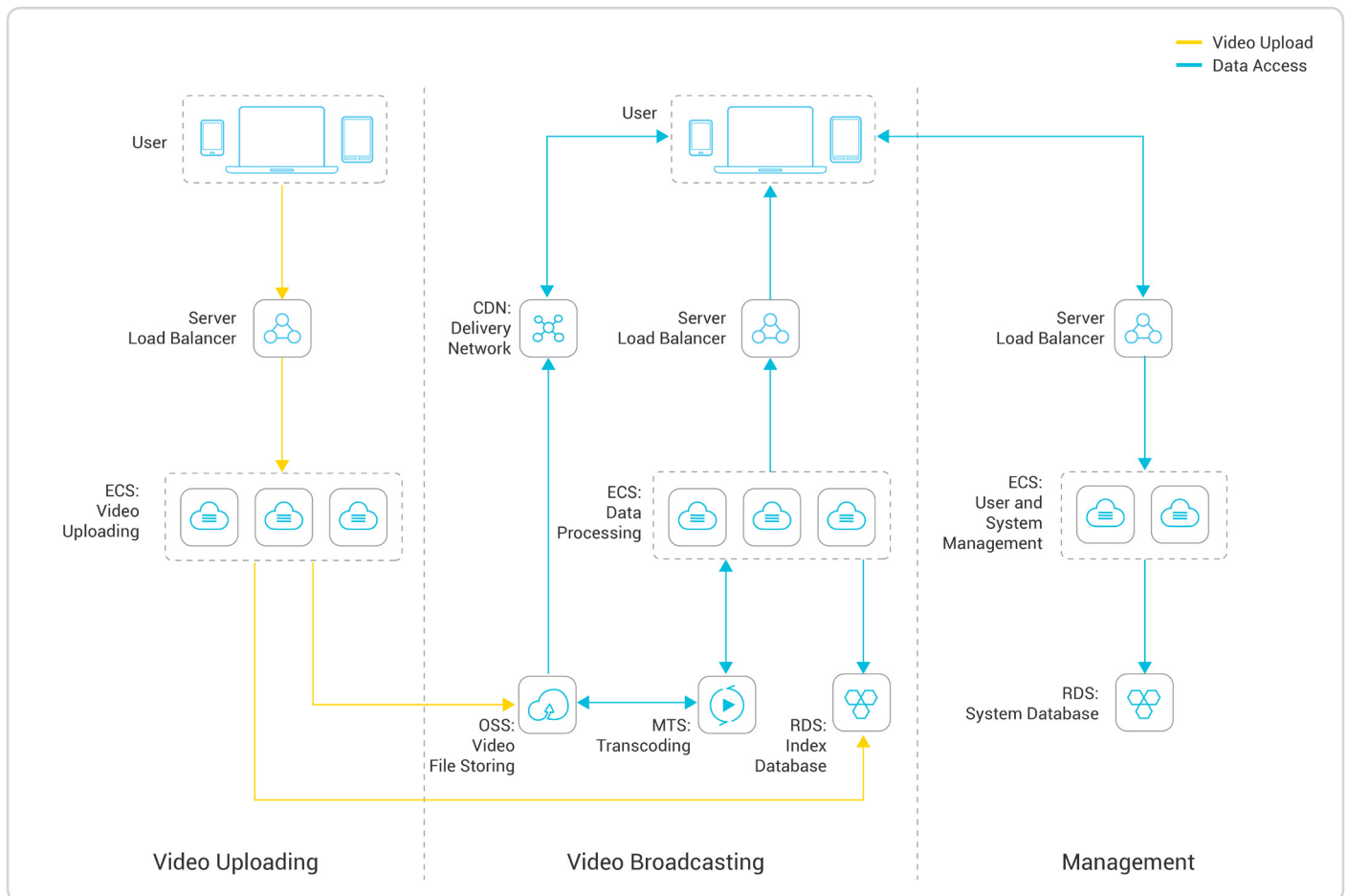


Diagram 3: Video on Demand - Classic Solution





### 4.3.2 Key Cloud Products Involved

OSS provides large video file storage capabilities by storing them in triplicate to ensure greater reliability of data. In addition, it is seamlessly integrated with MTS and CDN to significantly reduce development costs.

MTS provides transcoding services for video files. By configuring the service on the console, you can directly transcode the video files in OSS.

CDN provides high delivery capabilities of video files to the user terminal.

### 4.3.3 Solution Highlights

-  Reduces development costs with low cost video file storage with OSS and direct transcoding services with MTS
-  Unlimited scalability of VOD platform's web service, storage resources, and CDN at any time as required
-  Smooth playback experience delivered by way of on-demand audio and video incremental services
-  High-speed audio and video downloads using acceleration feature for on-demand media

## 4.4 Solution 2: Platform-based VOD Solution

### 4.4.1 Overview and Architecture Diagram

For VOD business scenarios, flow is as same as in the Classic Solution. But in this solution Alibaba Cloud provides a VOD service that helps you easily set up a flexible architecture. This service combines audio/video uploads, automated transcoding, media resource management, and accelerated delivery capabilities into a single all-in-one on-demand audio/video streaming solution. This solution makes use of flexible and scalable storage, processing, and delivery services to help enterprises and developers quickly construct secure, elastic, and highly customizable on-demand streaming platforms and applications. In the Video Uploading module, there is high availability of uploading files using Server Load Balancer and ECS. However, instead of directly storing to OSS, it is processed to a VOD service that integrates OSS, MTS, CDN, RAM, and Messaging services.

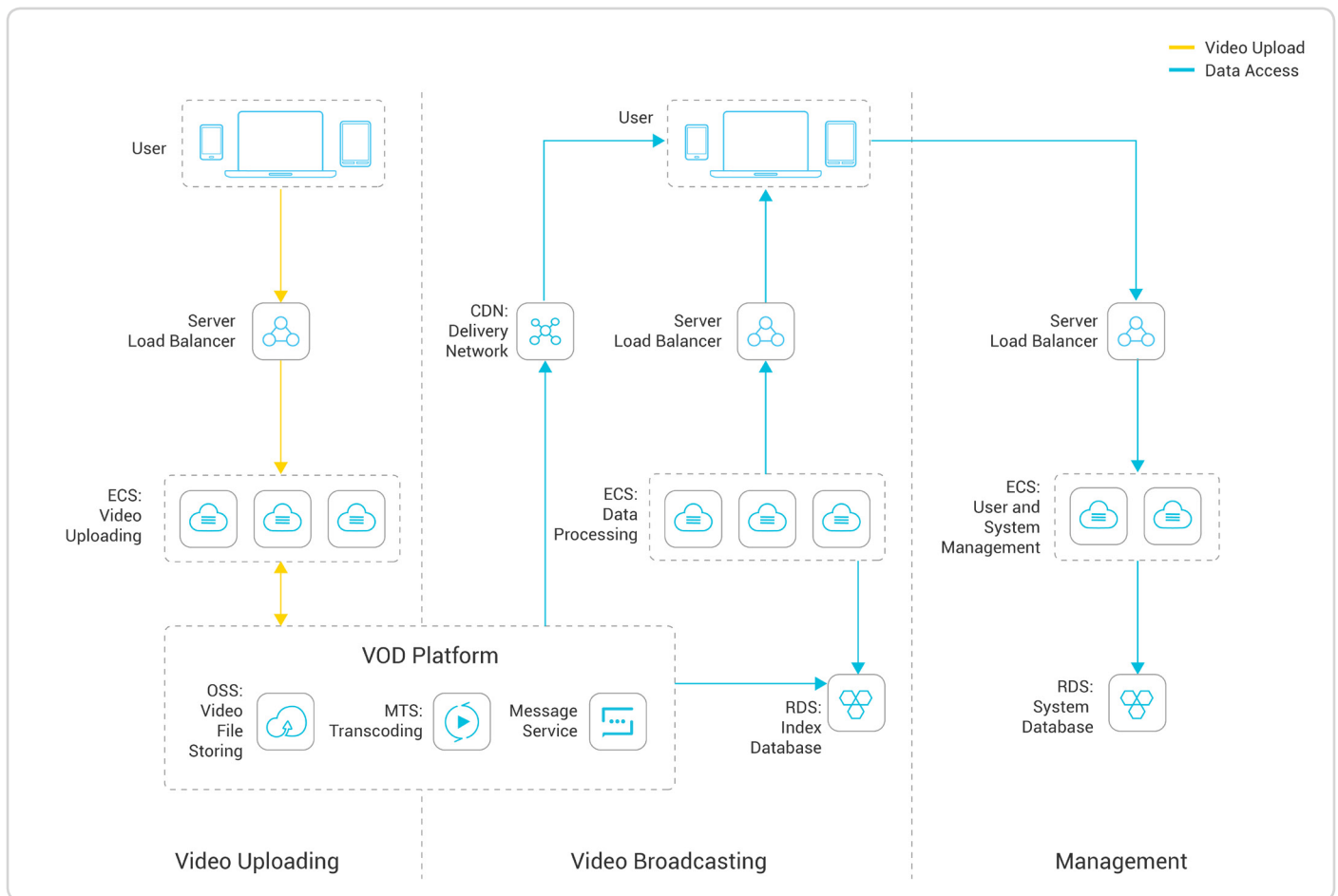


Diagram 4: Video on Demand - Platform-based VOD Solution

## 4.4.2 Key Cloud Products Involved

Alibaba Cloud VOD integrates OSS, MTS, CDN, RAM, and Message Service, allowing customers to quickly construct a cloud-based on-demand audio/video streaming solution. In just one click - without writing any code - you can create a typical cloud-based audio/video processing configuration that can be automatically triggered when a file upload is complete.

## 4.4.3 Solution Highlights

- Pay only for what you use, based on the type of VOD service selected
- Minimize maintenance costs by automatically scaling service capabilities without complicated architecture design and programming
- Undiluted focus on implementing business logic and improving user experience

## 05 Live Video Broadcast

### 5.1 Traditional Solutions and Challenges

Live video broadcasting is the fastest growing service in the audio/video industry. Traditional broadcasting solutions involve satellite communication and the Internet. Transcoding using physical transcoders was both cumbersome and full of challenges. This included the challenge of building a robust and cost-effective live-streaming ecosystem with high network quality, low latency, and smooth transcoding of streamed data.

### 5.2 Market Trends and Alibaba Cloud Multimedia Solutions

According to [Cisco's June 2016 Visual Networking Index Report](#), streaming video accounts for more than two-thirds of all Internet traffic and is expected to jump to 82 percent by 2020. The usage of mobile devices for streaming videos on a real-time basis has increased. Mobile video streaming apps help users watch, share and store videos from any location. In the next five years, it is expected that [50 percent of viewers will access streamed online videos from their smartphones](#). The increasing usage of cloud-based video streaming solutions is also helping the market grow, as it allows small companies to adopt these solutions without expanding their IT resources. Based on its industry-leading content access and delivery network capabilities, Alibaba Cloud provides quick access and smooth streaming, along with low-latency and high-concurrency live video broadcast solutions. This allows users to quickly and efficiently construct low-cost live video broadcast platforms.

### 5.3 Solution 1: Classic Solution

#### 5.3.1 Overview and Architecture Diagram

This solution has three modules: pushing stream, video broadcasting, and system management. In pushing stream, you can use a Server Load Balancer with ECS architecture to construct a real-time video segmentation cluster for segmenting video streams pushed by clients and later stored in OSS. In video broadcasting, authenticated users request live streaming, then a real-time video segment is converted to an HLS format and pushed to CDN to serve the request. The system management module is responsible for system management, including user information management, device management, user verification, and other system management-related services.

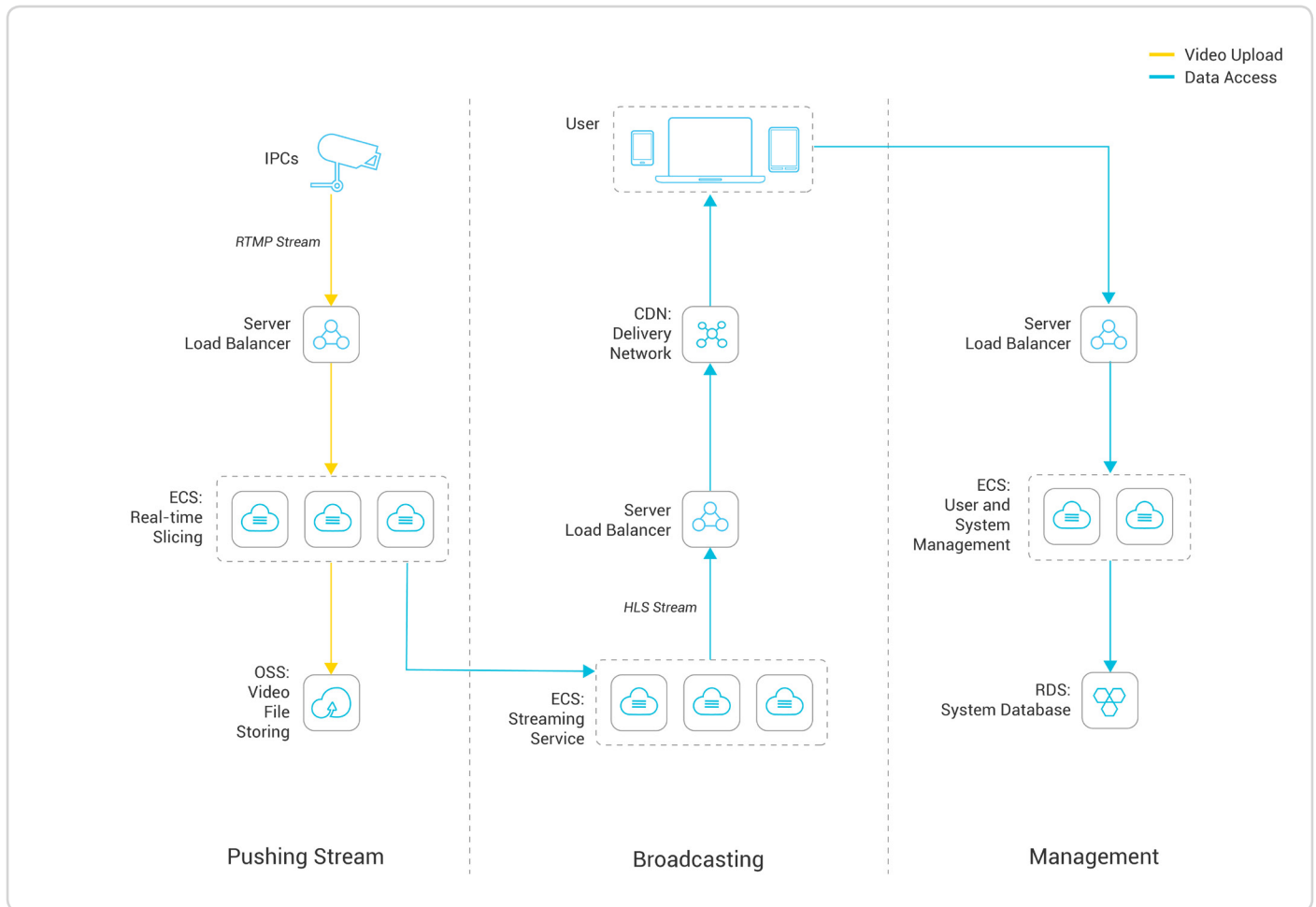




Diagram 5: Live Video Broadcast - Classic Solution

### 5.3.2 Key Cloud Products Involved

OSS provides a property called Append Object, which appends the data to a previously stored object (file) to prevent any data loss. It also allows the video stream to be stored directly from the ECS instance. The uploaded content can be accessed, even if this object (file) is not completely written, allowing file storage and video playback within seconds.

CDN provides high delivery capabilities of video files to the user terminal for live streaming.

### 5.3.3 Solution Highlights

-  High level of flexibility as users can customize the solution based on their needs
-  Provides smooth migration for live broadcast platform architecture that is based on a traditional data center

## 5.4 Solution 2: OSS-based RTMP Access Solution

### 5.4.1 Overview and Architecture Diagram

In this solution OSS provides access to live broadcast RTMP streams and real-time segmentation and delivery capabilities. OSS enables you to quickly construct a live video broadcast platform. Unlike the Classic Solution, it significantly reduces development costs by removing the need to segment video streams.

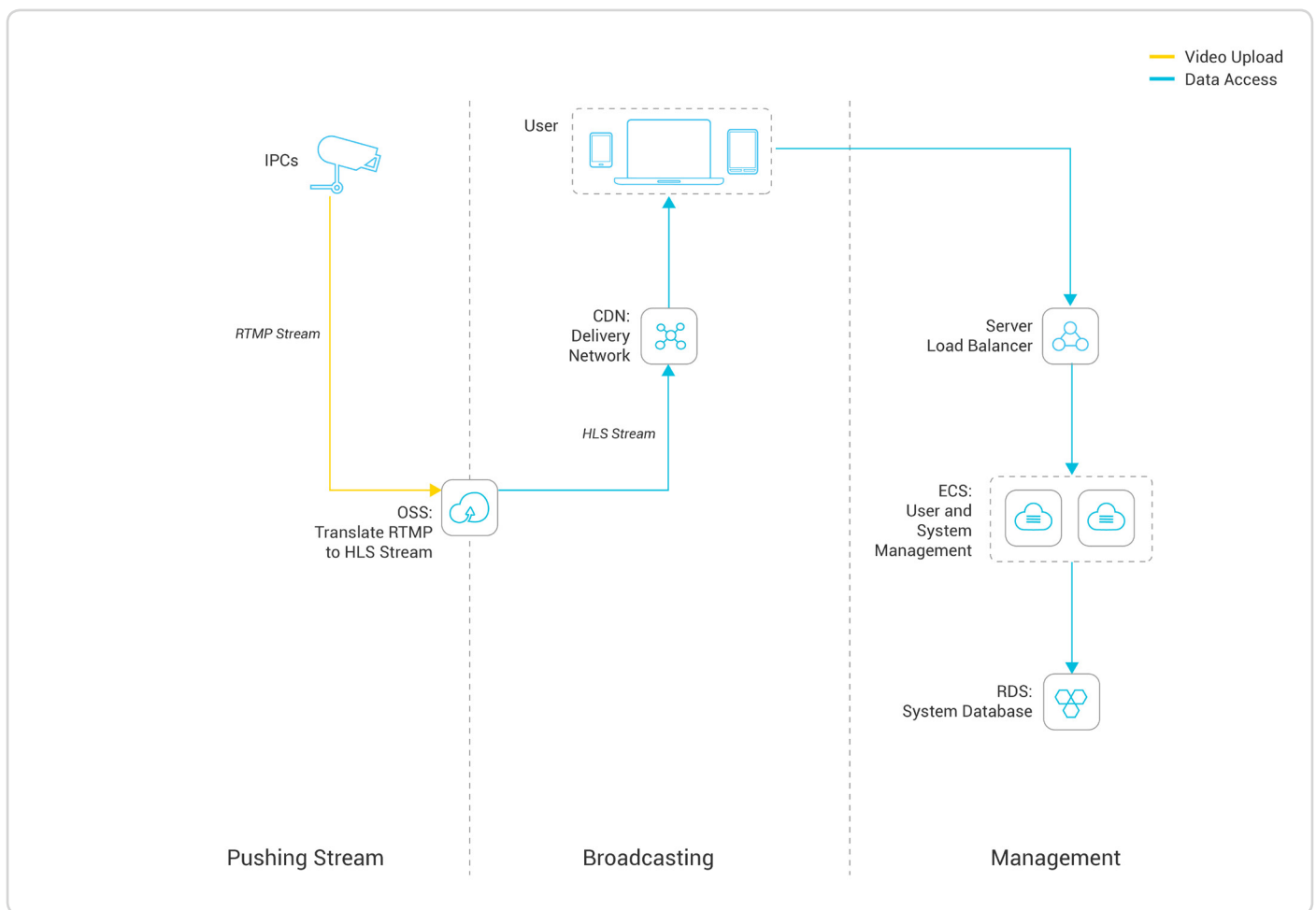




Diagram 6: Live Video Broadcast - OSS-based RTMP Access Solution

### 5.4.2 Key Products Involved

OSS quickly translates RTMP stream to HLS stream and has delivery capabilities to directly serve media.

CDN provides high delivery capabilities of the HLS video stream for the authenticated end-user.

### 5.4.3 Solution Highlights

-  Greatly simplifies the development process with no additional development required as video stream access, segmentation, and delivery to CDN are all completed by OSS
-  Applicable to live video broadcast scenarios where no special functions or services are required

## 5.5 Solution 3: Platform-based Live Video Broadcast Solution

### 5.5.1 Overview and Architecture Diagram

Alibaba Cloud provides the Live Video service to lower technical thresholds and satisfy the varied business needs of customers. This service is a live video broadcast platform based on Alibaba Cloud's industry-leading content access and delivery network capabilities, along with its large-scale, distributed real-time transcoding technology. It provides quick access, clear and smooth streaming, low-latency, and high-concurrency live video broadcast service. Live Video is an end-to-end solution that allows you to provide video stream access, transcoding, storage, screen capture, delivery, and other functions through console configurations to minimize the technical threshold for live video broadcasting.

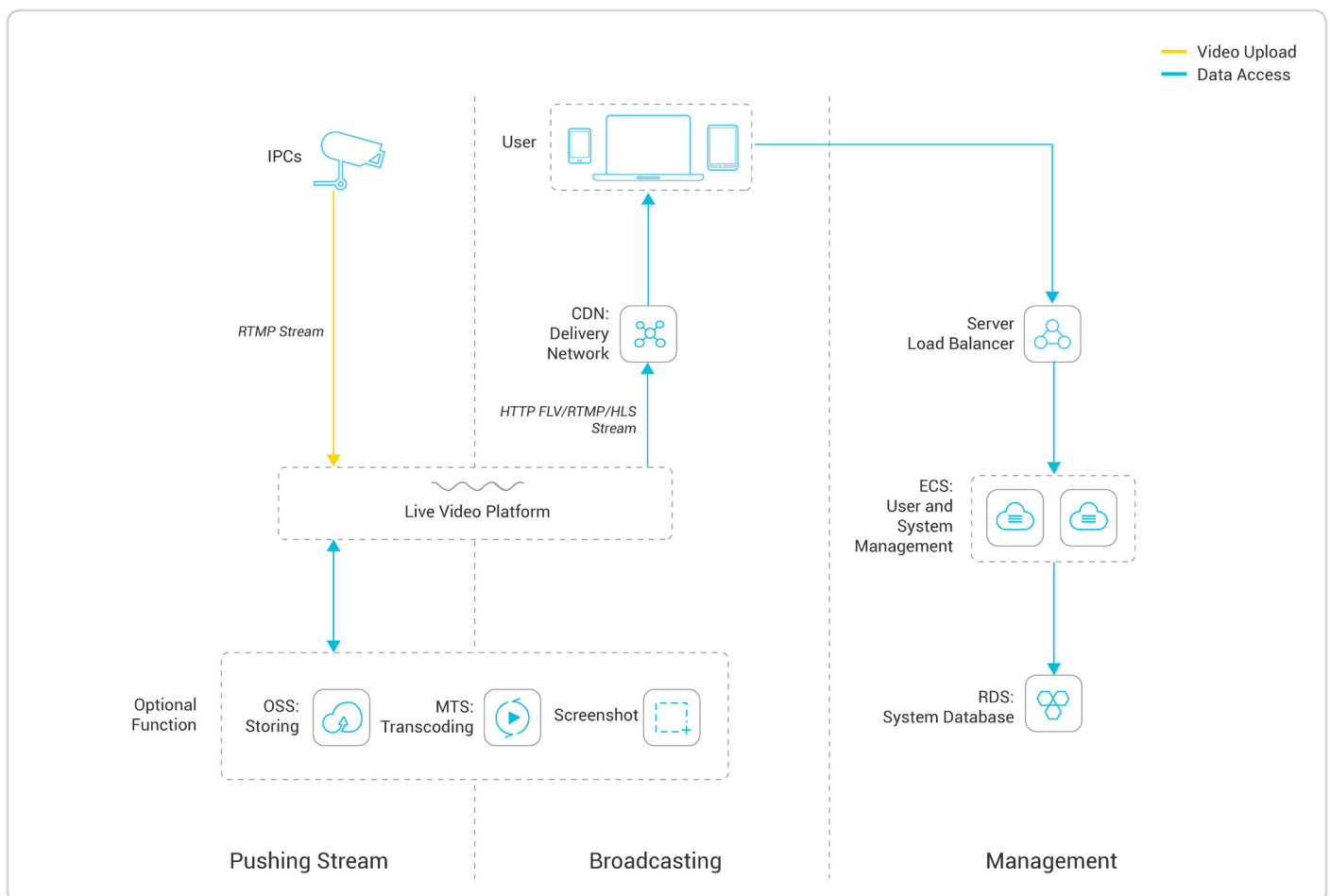


Diagram 7: Live Video Broadcast - Platform-based Live Video Broadcast Solution



### 5.5.2 Key Cloud Products Involved

Alibaba Cloud Live Video integrates with OSS, MTS, and RAM and also provides the functionality of Screen Capture services. It minimizes the technical threshold for live broadcasting. It also has delivery capabilities that are integrated with CDN.

### 5.5.3 Solution Highlights



End-to-end solution that significantly lowers development costs



Provides access, transcoding, storage, delivery, and other functions



Provides custom functions, such as screen capture, recording, dynamic watermarking, and elicit video content detection

## 5.6 Solution 4: International Live Video Broadcast Solution

### 5.6.1 Overview and Architecture Diagram

For international live video broadcasting, Alibaba Cloud provides a solution that combines a leased line and proxy (ECS service). The proxy service automatically distributes the live stream to a peer CDN using ExpressConnect to ensure optimum quality data transmission for international live video broadcasting.

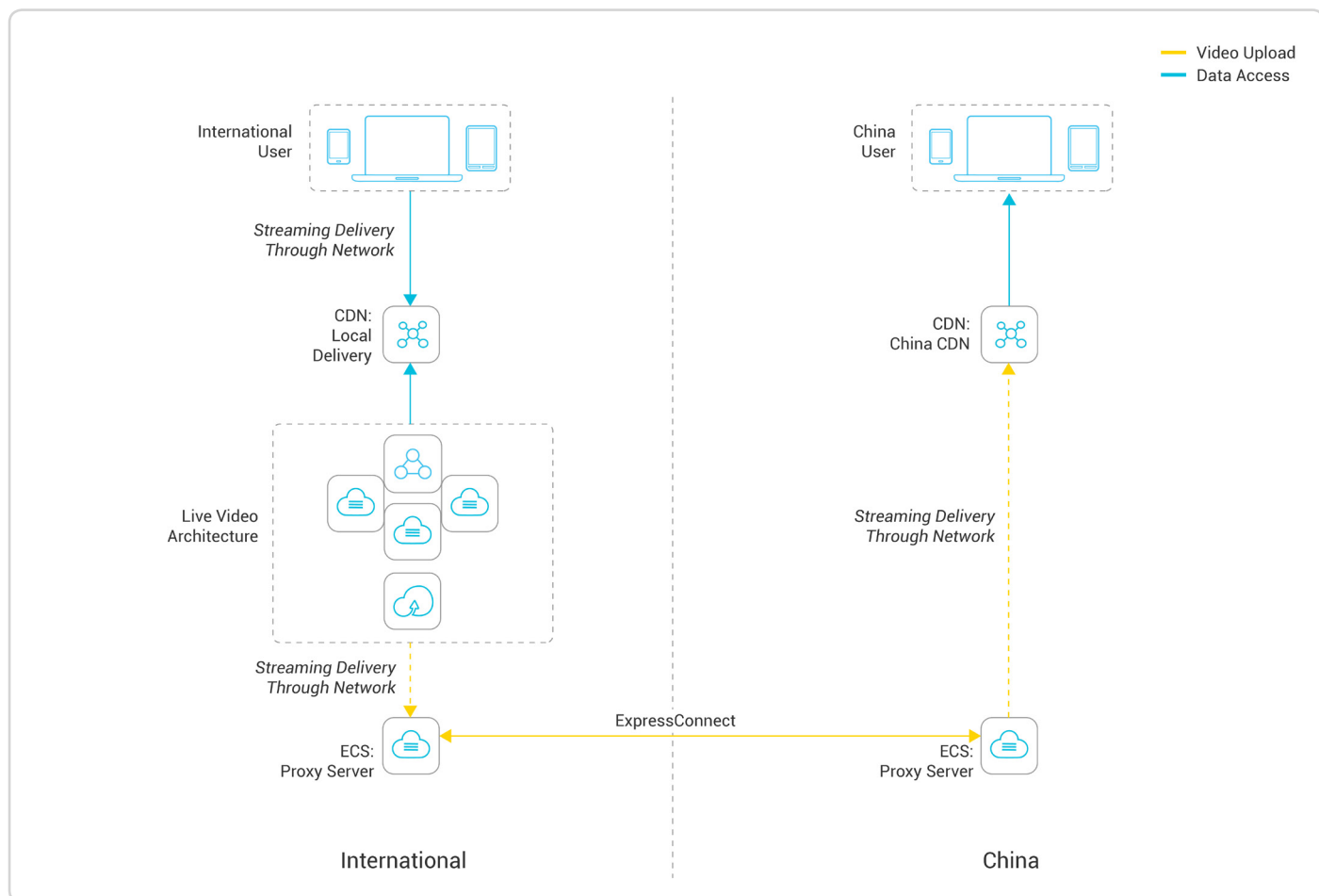




Diagram 8: Live Video Broadcast - International Live Video Broadcast Solution

## 5.6.2 Key Cloud Products Involved

ExpressConnect joins different network environments for both sides of the network to communicate directly via an intranet and bypass public networks. Even over a long distance, users have access to low latency and high bandwidth comparable to intranet communication.

## 5.6.3 Solution Highlights

-  ExpressConnect ensures low latency, stable quality, and other features for transmission quality of live broadcast data
-  Completely transparent without any additional technical complexity

## 06 Conclusion

The advent of cloud computing and its ability to keep pace with the speed of innovation has removed barriers of time, distance, and storage space to create endless possibilities for the global multimedia industry. Multimedia companies can now build an efficient ecosystem without dedicated infrastructure or large capital expenditure, while also expediting time-to-market.

Of course these companies need to assess their positioning in the digital supply chain and how best they can utilize cloud computing to augment and improve their service-oriented architecture.

Alibaba Cloud is emerging as a leader in providing rich tailor-made multimedia services by delivering high-quality digital content with low latency through its robust network of data centers across the globe.

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