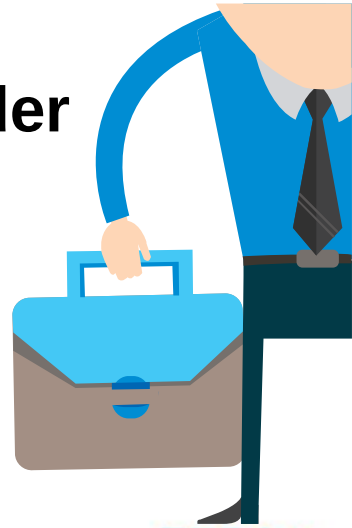
The CDN evolution under 5G

ZTE Corporation

Table of contents

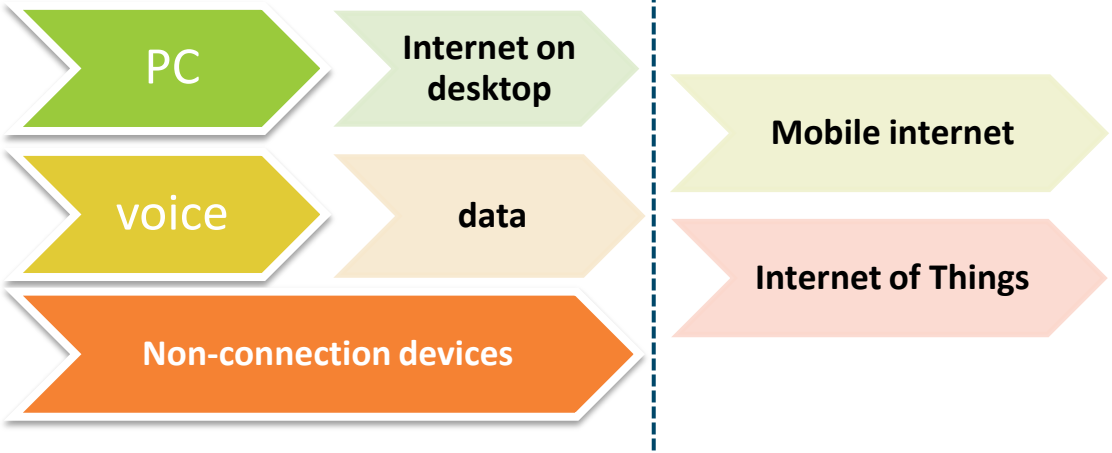
1、The multimedia service features under 5G scenario

2、 The key technologies affecting CDN evolution under 5G



01 The multimedia service features under 5G scenario

Mobile Internet and IoT drives 5G innovation as the major forces



- ✓ For Big Video service, the video service is still the primary service in the mobile Internet under 5G scenario.
- ✓ Different from Big Video service, IoT service generates huge amount of small data, e.g. status data. Acceleration is not the major requirement. But it needs high computation capability at the edge.

Typical 5G services

Video communication

Video playing

Mobile on-line game

AR

VR

Real-time video sharing

Cloud desktop

Non-data downloading

Cloud storage

HD pic uploading

OTT message

Visual surveillance

Smart home control

IoV safe driving

8 user scenarios for 5G services

High-density(office)

High-mobility (highway)

numerous connections (stadium)

residence

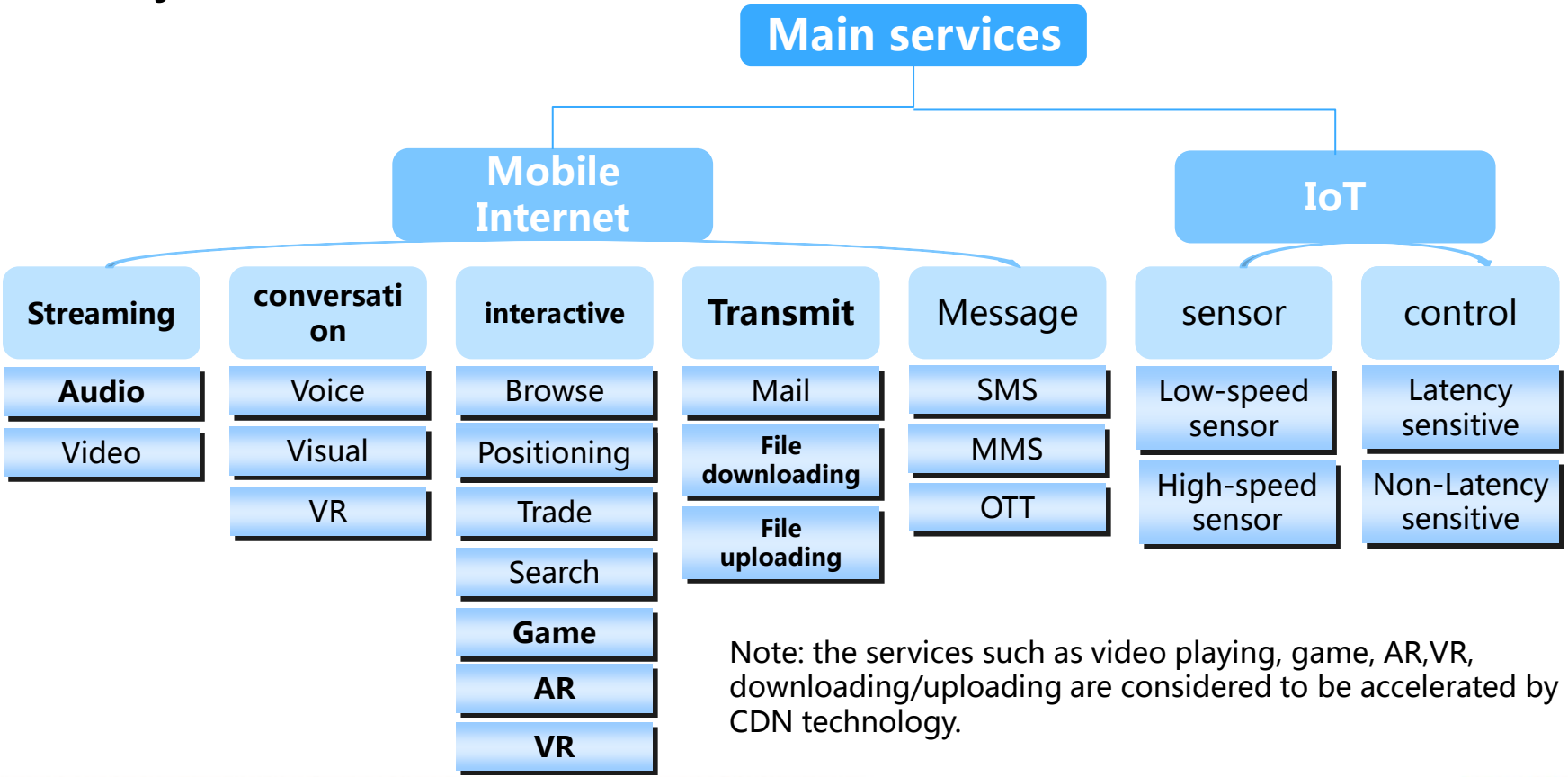
high-speed rail

public assembly

Metro

Wide area coverage

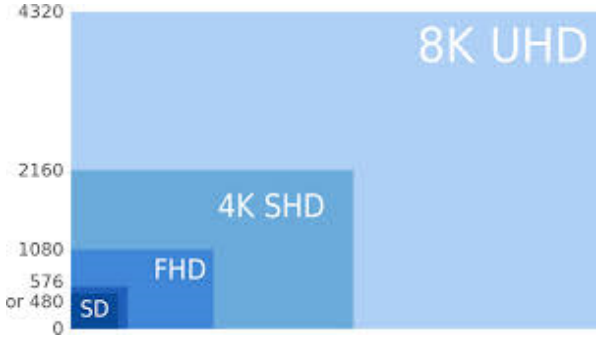
The major services of future mobile communication

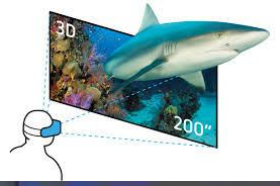


Note: the services such as video playing, game, AR,VR, downloading/uploading are considered to be accelerated by CDN technology.

The trend of streaming and conversation service

UHD,3D,immersive are the future tendency





3D

Immersive

Service features and challenge

Throughput	Traffic density	Latency
✓ 8K (3D) **non-compressed video ≈ 96Gbps** ✓ **Compressed video ≈ 960Mbps**	✓ **Ultra high traffic density**	✓ **Latency ≈ 50-100ms**

The trend of interactive service

Interactive service

AR

On-line game

Could desktop

VR

Challenges

Quickly response

non-sensitive latency user execperience (5-10ms)

Mass of data interaction

AR, VR, on-line game require real-time HD video interaction. The transmission rate of downstream and upstream meets challenges.

The trend of transmission and message service

Transmission service

cloud storage will be one of the primary service

Main challenge

High-speed transmission

Comparable to the optical fiber transmission rate （~1Gbps）

High traffic density

Tremendous traffic generated in a density occasion, challenges to the network capacity.

Message service

OTT message（Instant message ）will be one of the primary service

Main challenge

Signaling costs

Plenty of data packets exchange cost signaling resource

The trend of IoT services

Smart home

Smart agriculture

Environment surveillance

- ✓ Tremendous devices connection
- ✓ Plenty of small packets concurrence
- ✓ Coverage
- ✓ Low cost
- ✓ Battery life

Smart traffic

Smart grid

Industry control

- ✓ Latency in ms level
- ✓ almost 100% reliability

- ✓ Transmission rate

Visual surveillance

Mobile finance

- ✓ Multi-level security mechanism

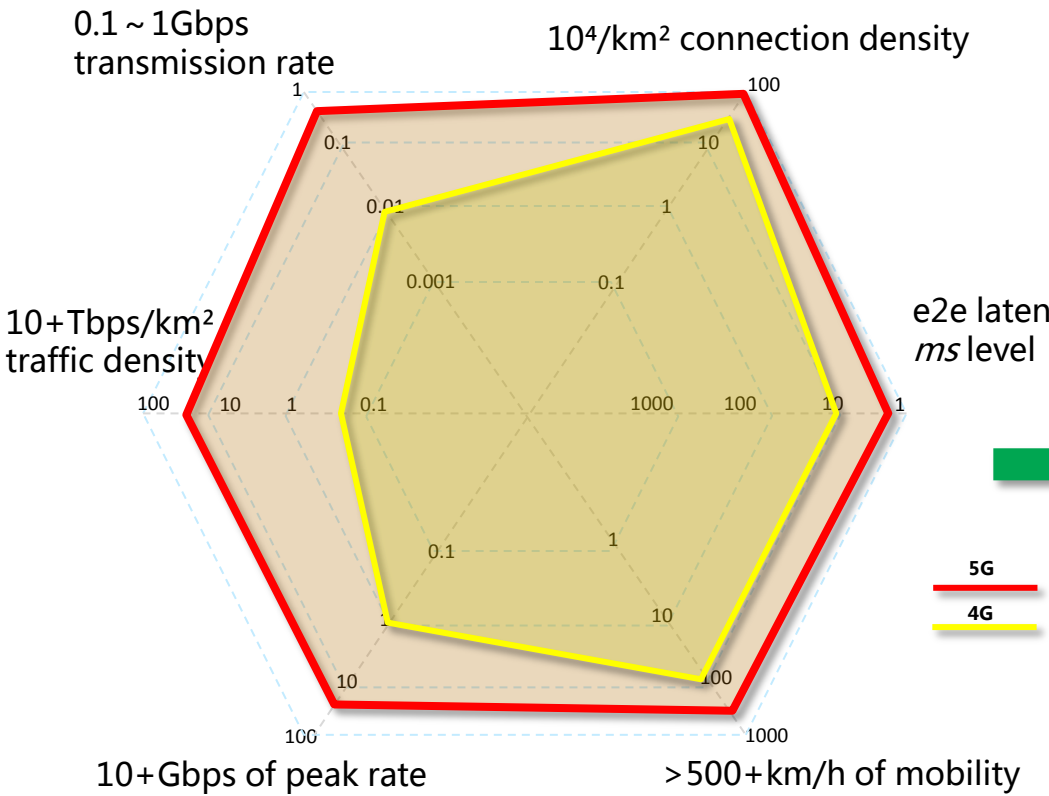
Service model（video）

Typical service	Excepted capability	Requirement for transmission rate	Requirement for latency	Main challenge
Video communication	Uplink: support transmission of 1080P	✓ Impact factors ➢ definition ➢ bits per pixel ➢ fps ➢ Compression ratio ✓ Expect bandwidth: ➢ 1080p，12bits/pixel，60fps →15Mbps ➢ 4K，12bits/pixel，60fps →60Mbps ➢ 8K，12bits/pixel，60fps →240Mbps ➢ 8K（3D），24bits/pixel，120fps，(ordinarily compression) →960Mbps	50~100ms	15Mbps (UL&DL)
UHD video playing	Downlink: 8K video transmission in static scene; 4k in medium-speed scene; 1080p in low-speed scene		50-100ms (best QoE)	1080P:15Mbps (DL) 4K:60Mbps (DL) 8K:240Mbps (DL)
AR	Uplink/downlink: support transmission of 1080P Non latency sensitive for user		5-10ms	15Mbps(UL&DL) 5~10ms
VR	Downlink: 8K（3D）UHD video transmission support		50~100ms	960Mbps (DL)
Real-time video sharing	Uplink: 4K video transmission support		50~100ms	60Mbps (UL)
Visual surveillance	Uplink: 4K video transmission support		50~100ms	60Mbps (UL)

Service model（data）

Typical service	Basic requirement	Transmission rate	Latency required	主要挑战
Cloud desktop	Data transmission on uplink/downlink	UL/DL ≈ 20Mbps	According to the fastest response time of the optic nerve in human eyes, unidirection E2E=10ms, excluding device processing time.	20Mbps (DL&UL) E2E = 10ms
Download by wireless/ Cloud storage	Comparable to the optical fiber transmission rate	DL ≈ 1Gbps，UL ≈ 0.5Gbps	*No more difference*	1Gbps(DL) 0.5Gbps(UL)
HD image upload	40M pixs image upload	File size ≈ 20MB（160Mb），depends on different cases	*No more difference*	Depends on different cases
Smart home	10~20 home devices connection, high density requirement	*No more difference*	*No more difference*	Numbers of connection：15/home
IoV	IoV Latency satisfied	*No more difference*	latency for car hitting protection	5ms
On-line gaming	Low latency required	*No more difference*	Action/shooting game: 15-40ms for unidirection E2E	15-40ms

Key features of 5G：high throughput, low latency



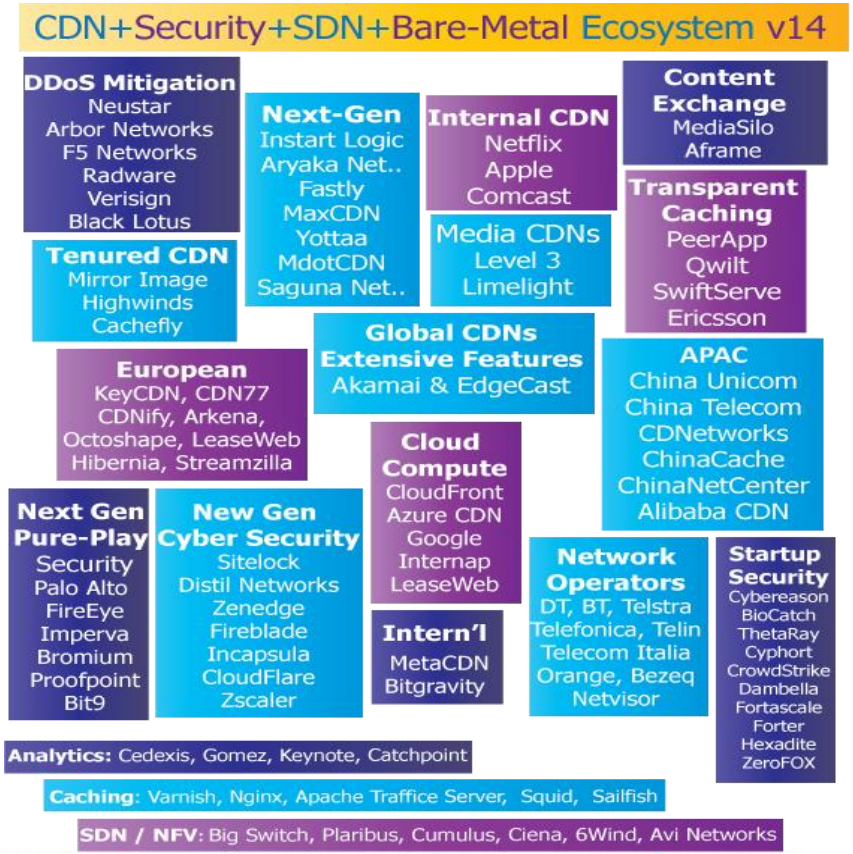
Potential requirement for the service framework under 5G

- The flatter architecture
- More convenient content distribution
- More flexible network orchestration
- Simplified mobility management
- Efficient resource management
- More secure network

02

The key technologies affecting CDN evolution under 5G

CDN ecosystem grows up



CDN ecosystem grows up in a high speed. Many enterprises including in SDN, security, NFV scope has been entering in the new ecosystem.
The diagram (reference from Bizety 2015) shows the main companies and the potential technology evolution trend.

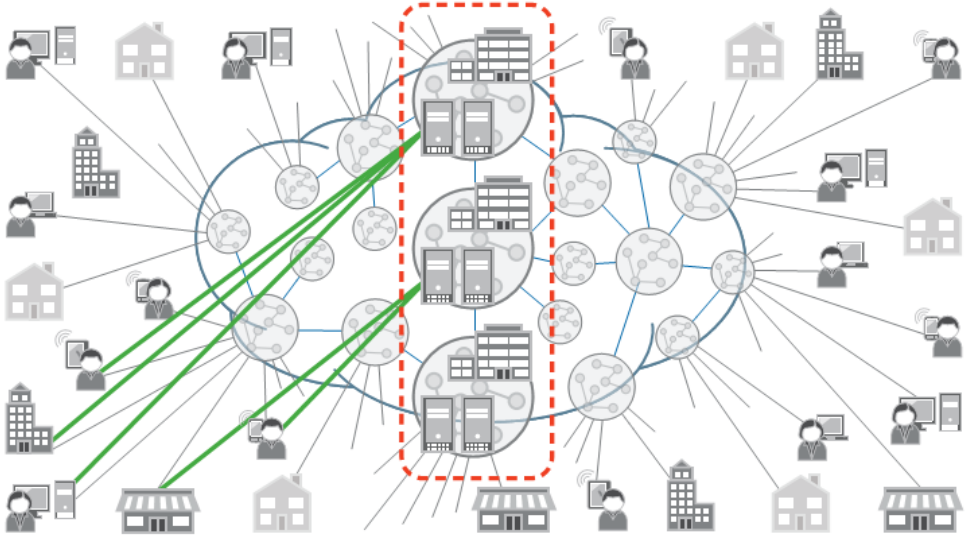
The challenge for CDN and solutions

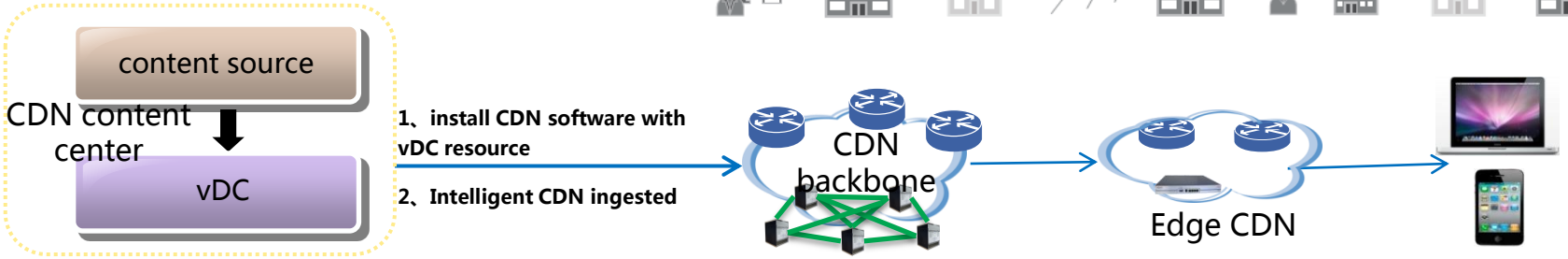
CDN challenges :

- ✓ The cache node should be close to user but with low cost
- ✓ The new cache node created and deployment depends on the manual work
- ✓ Inflexibility of Function deployment
- ✓ Inefficient usage of computing, network, storage resource
- ✓ Inefficient configuration and management
- ✓ insensitive to the new services changing

Possible solutions：vDC(vCDN)+SDN

- ✓ It is the trend of CDN evolution
- ✓ the high efficient and flexible service capability and resource usage
- ✓ Decrease the investment by virtualized system

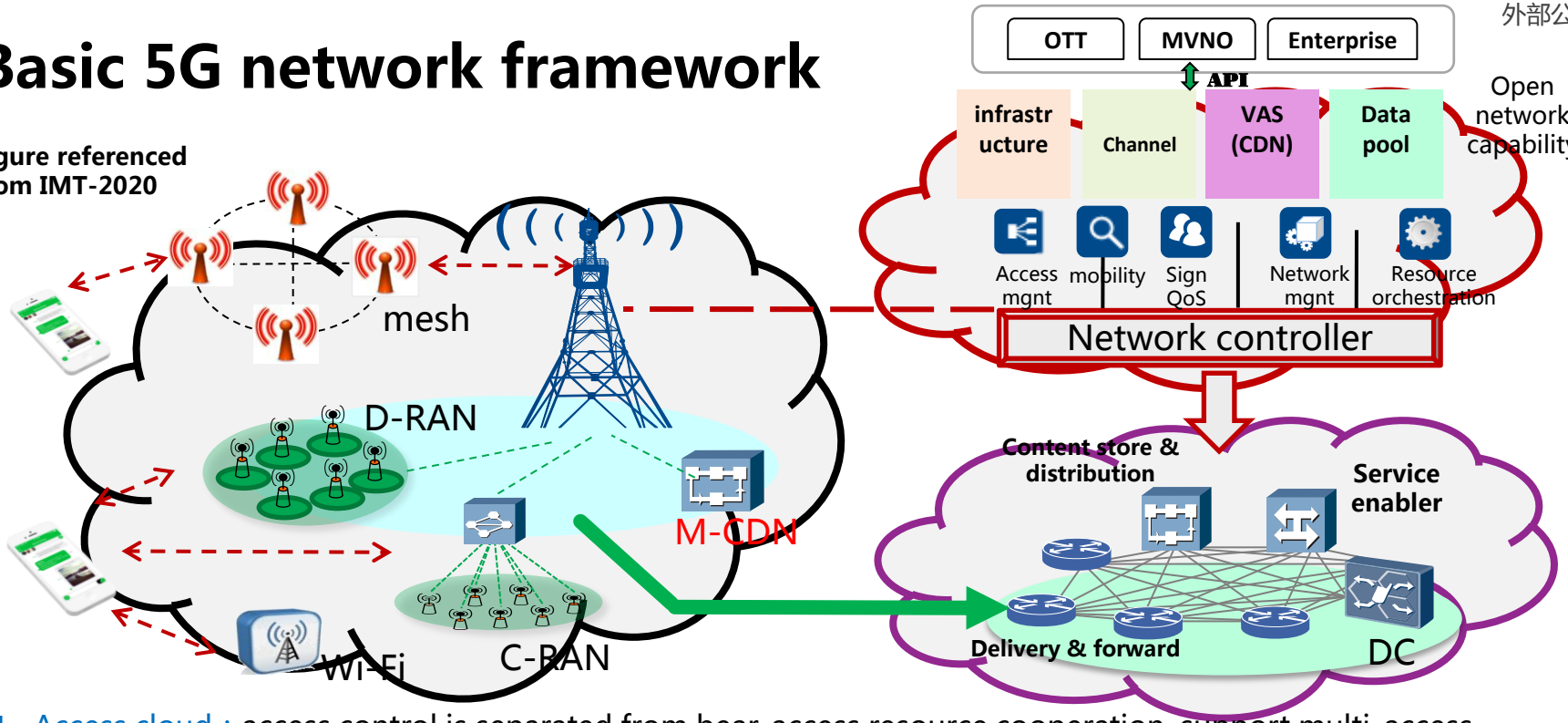




Functionality ingestion | **Content distribution & acceleration** | **QoE improved**

Basic 5G network framework

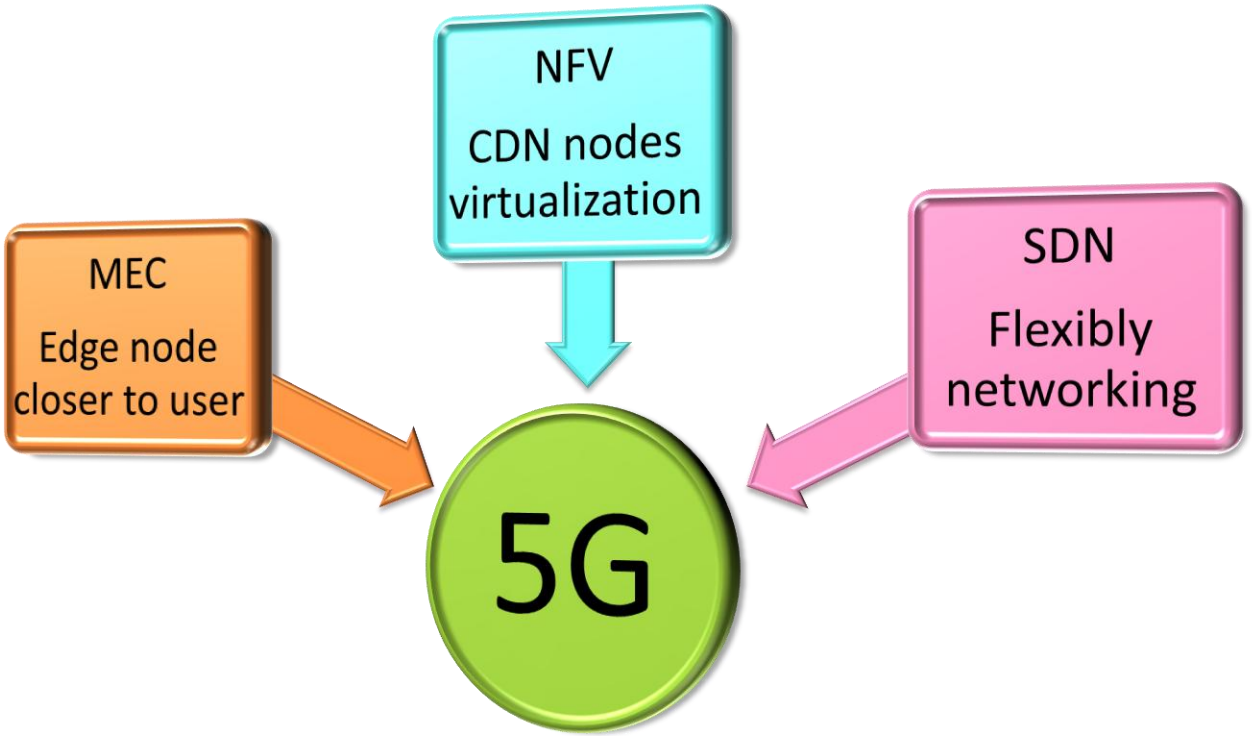
Figure referenced from IMT-2020



- Access cloud：access control is separated from bear, access resource cooperation, support multi-access scenarios（central/distributed/mesh）, flexible network capability and topology
- Control cloud：centralized network control，NFV, software-oriented, reconstructable, open network capability；
- Forward cloud：separated controller, forwarding near base station, converged service and forwarding capability.

Access cloud (flexible), control cloud (smart), forward cloud (high-efficient, low cost)

The key technology of CDN evolution under 5G



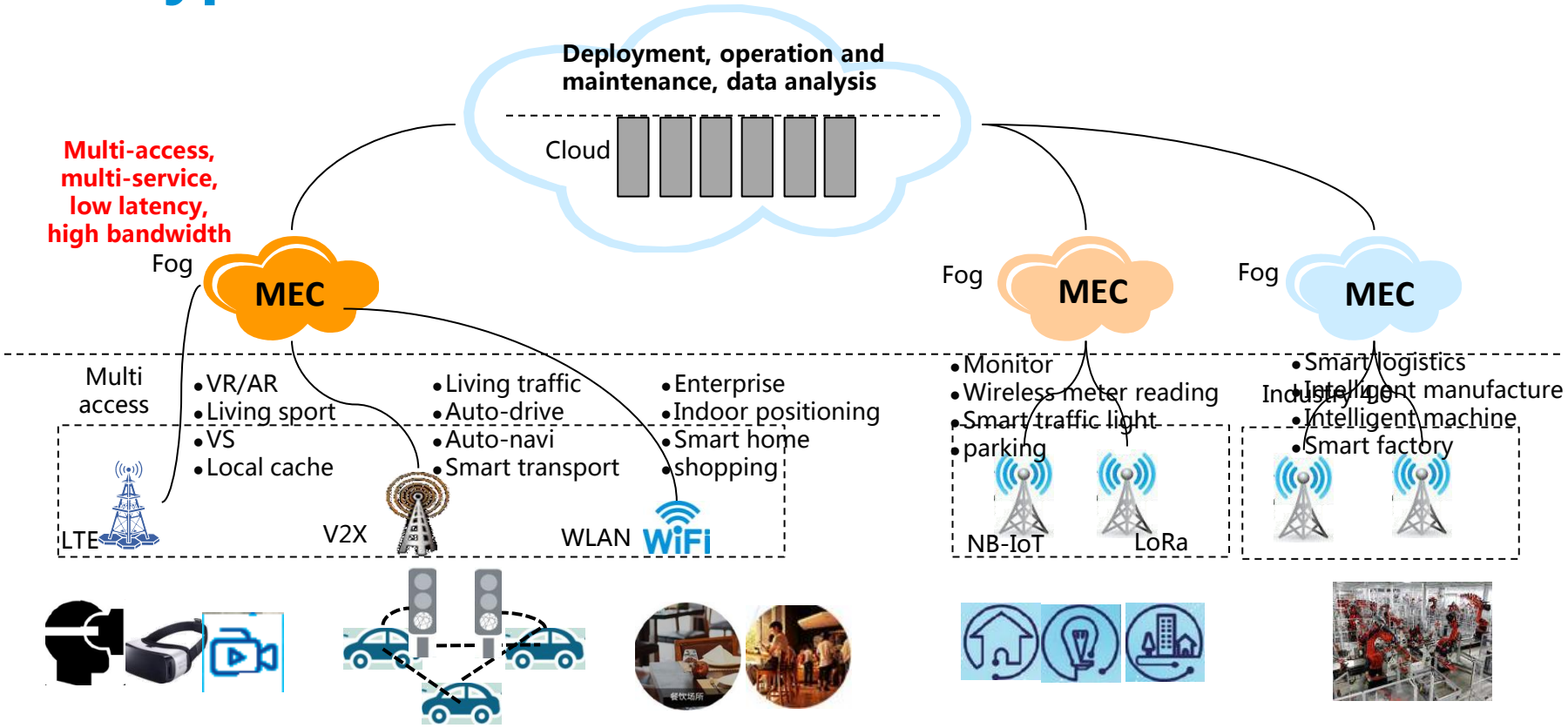
MEC– more convenient content delivery close to user

Mobile Edge Computing

- ✓ Mobile (sometimes called Multi-access)
  - ➢ Refers to the access mode， such as LTE、WiFi、fixed-line，even ZigBee、LoRa、NBIoT（the IoT user case)
  - ➢ Also refers to the ubiquitous consistent user experience.
- ✓ Edge
  - ➢ For reducing the latency, the network functions and applications are deployed at the edge of network, close to the user as much as possible.
- ✓ Computing
  - ➢ It's Cloud + Fog computing. Cut down the cost of building and operating a large scale network.

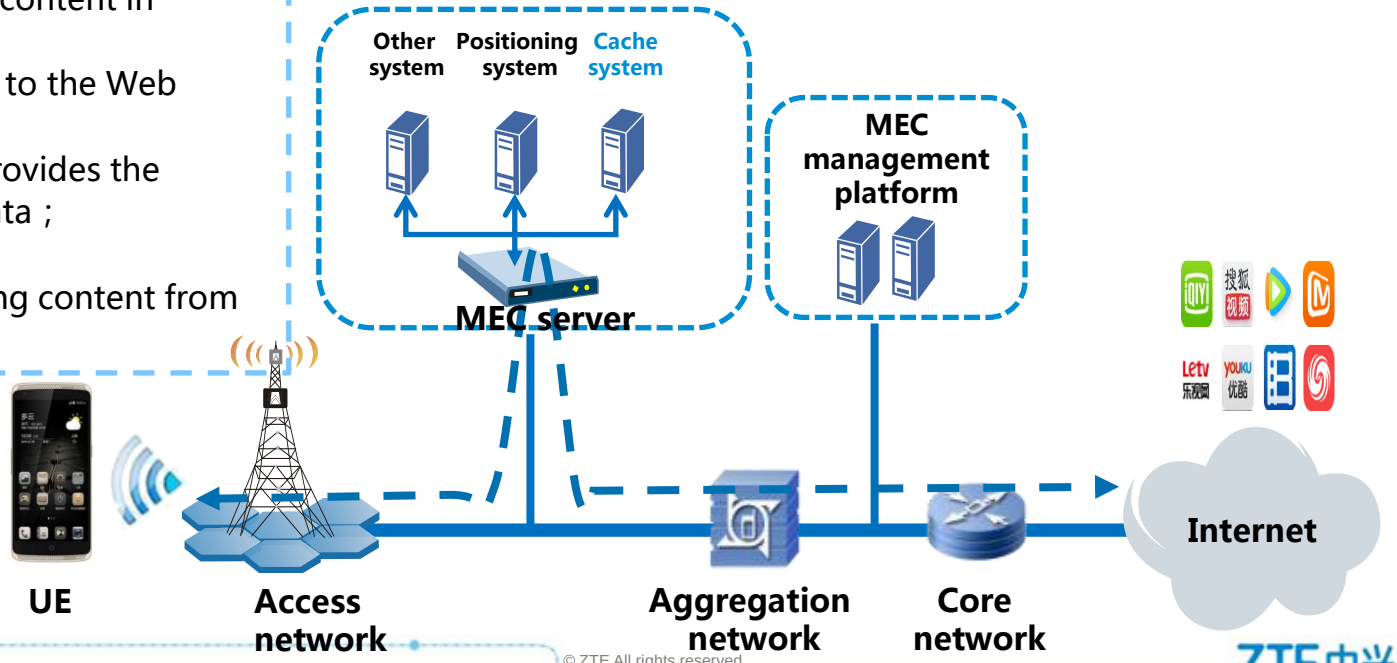
MEC enables the services to be deployed at the edge of network. With the features of low latency, ultra high throughput and strong real-time performance, it is expected to be a ideal platform which could aggregate IT and CT services.

The typical MEC scenario

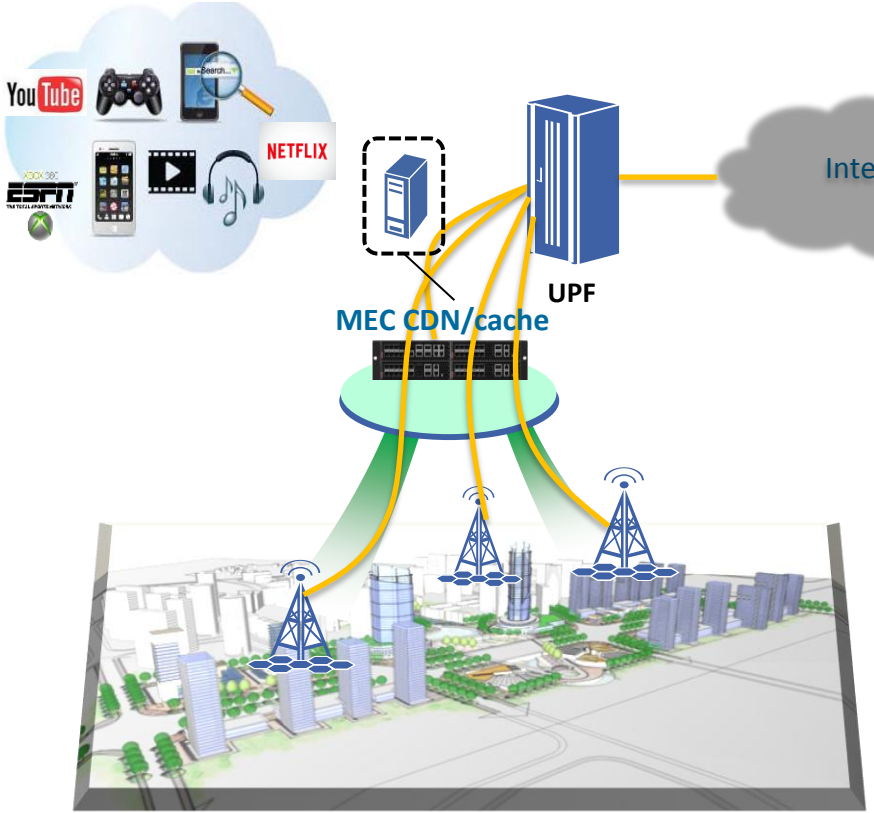


5G MEC Cache--mobile Internet cache acceleration

- ✓ **Scenario：**mobile Internet content cache
- ✓ **Deploy position：**near base station or Distributed gateway
- ✓ **Functions：**
  - ➢ Cache hot or specific content in Internet；
  - ➢ Redirect user request to the Web Cache system；
  - ➢ Web Cache system provides the request content or data；
- ✓ **Benefits：**
  - ➢ Avoiding downloading content from Internet directly



Cache & CDN Based on MEC Server, Video Site



Cache & CDN Applications Deployed on MEC

Better video experience by:

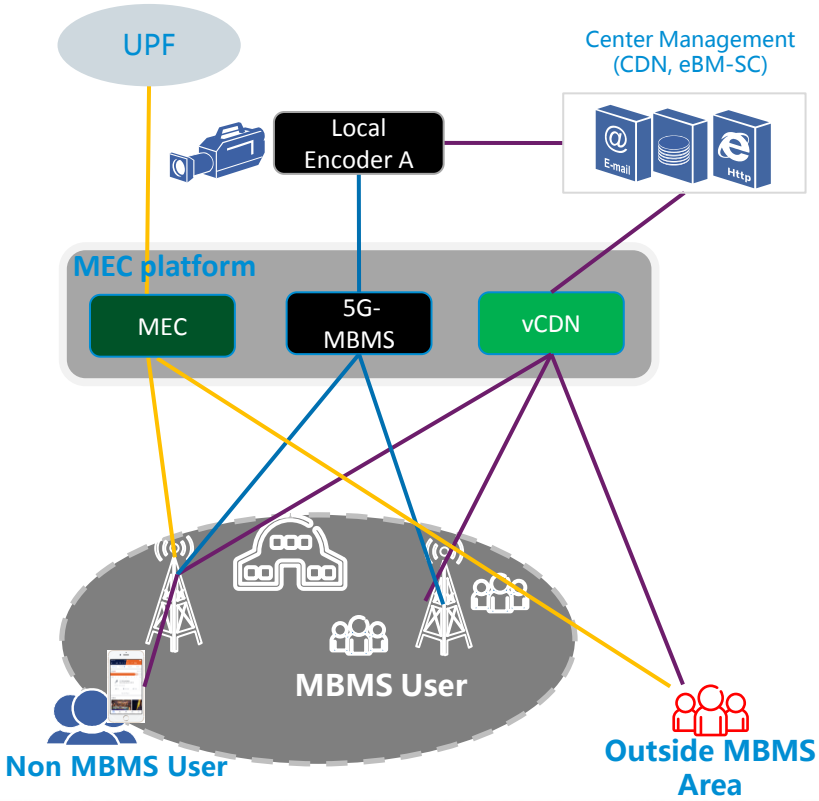
✓Intelligent video optimization

✓Content pre-stored on the edge of mobile network

- Network bandwidth used ↓ 40%
- Speedup to video network ↑ 17 times
- Speedup of HTTP download ↑ 22 times
- Speedup to Web ↑ 3.5 times

Hot Content with Low Latency

Case 2: Simplified MEC Video Solution for Stadium Scenario



MEC video solution supports 5G-MBMS and OTT live video hybrid for all users:

- **MBMS User:** Handset supports 5G-MBMS, user can watch broadcast video by 5G-MBMS APP.
- Non MBMS User: Hand set doesn’ t support 5G-MBMS，user can watch video by operator’ s OTT app client through unicast data traffic 。
- Outside MBMS Area: User can watch video by operator’ s OTT app client through unicast data traffic.

SDN-based CDN– more flexible network orchestration

CDN

➢The principle of CDN is quickly and stably content delivery.

➢CDN is a overlay network, over the current bearer network.

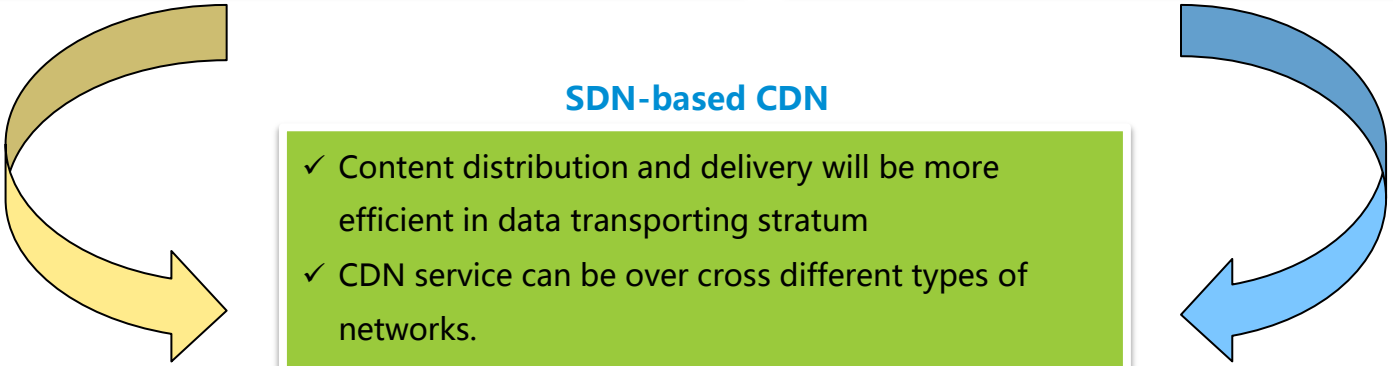
➢Redirecting the user request to the server node closest to the user, according to the network traffic, server loading status, the geographic distance to user, response time, etc.

➢Multiple services supported intention.

SDN

➢The purpose of SDN (Software Defined Network) is to separate the transmission control from the data forwarding.

➢The feature of SDN makes the network resource be orchestrated dynamically. Thus, the traffic control can be more flexible and intelligent.



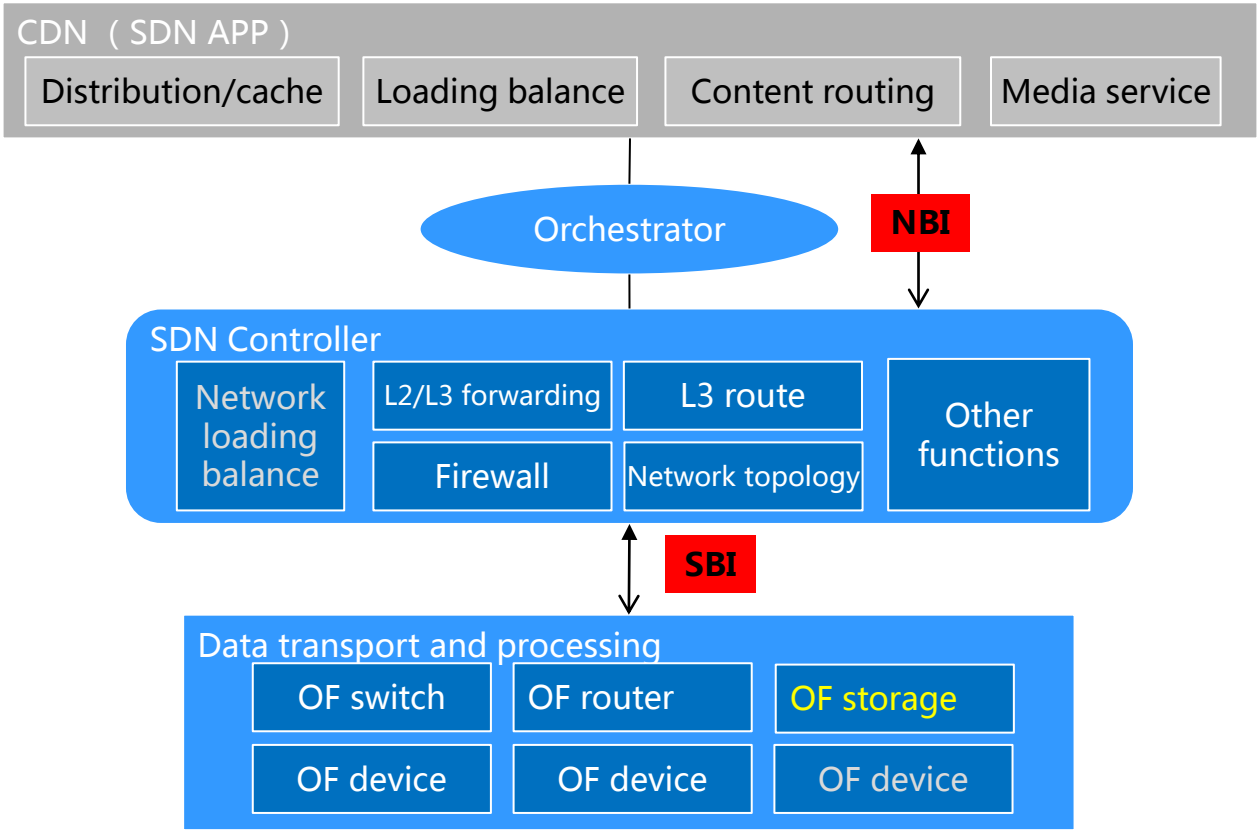
SDN-based CDN

✓ Content distribution and delivery will be more efficient in data transporting stratum

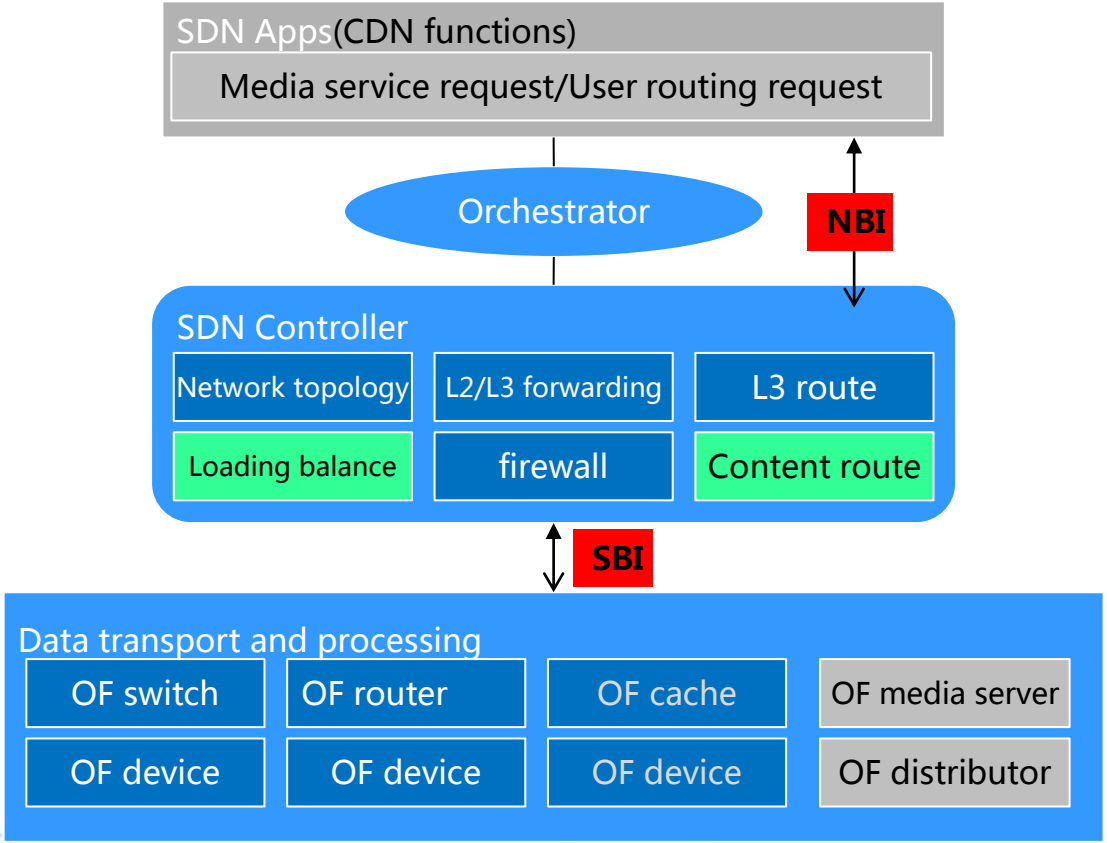
✓ CDN service can be over cross different types of networks.

✓ A large scaled CDN node can be laid on the different DC by using SDN.

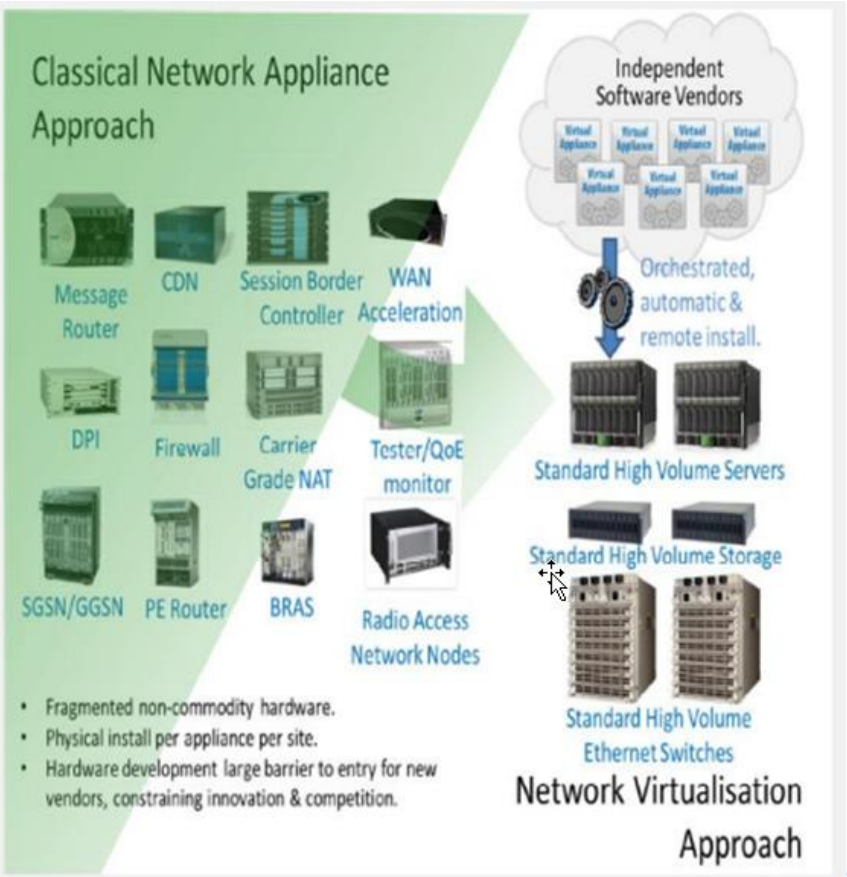
The framework of SDN-based CDN: tight coupled type



The framework of SDN-based CDN: loose coupled type



NFV features



Source: Vision for Network Functions Virtualization

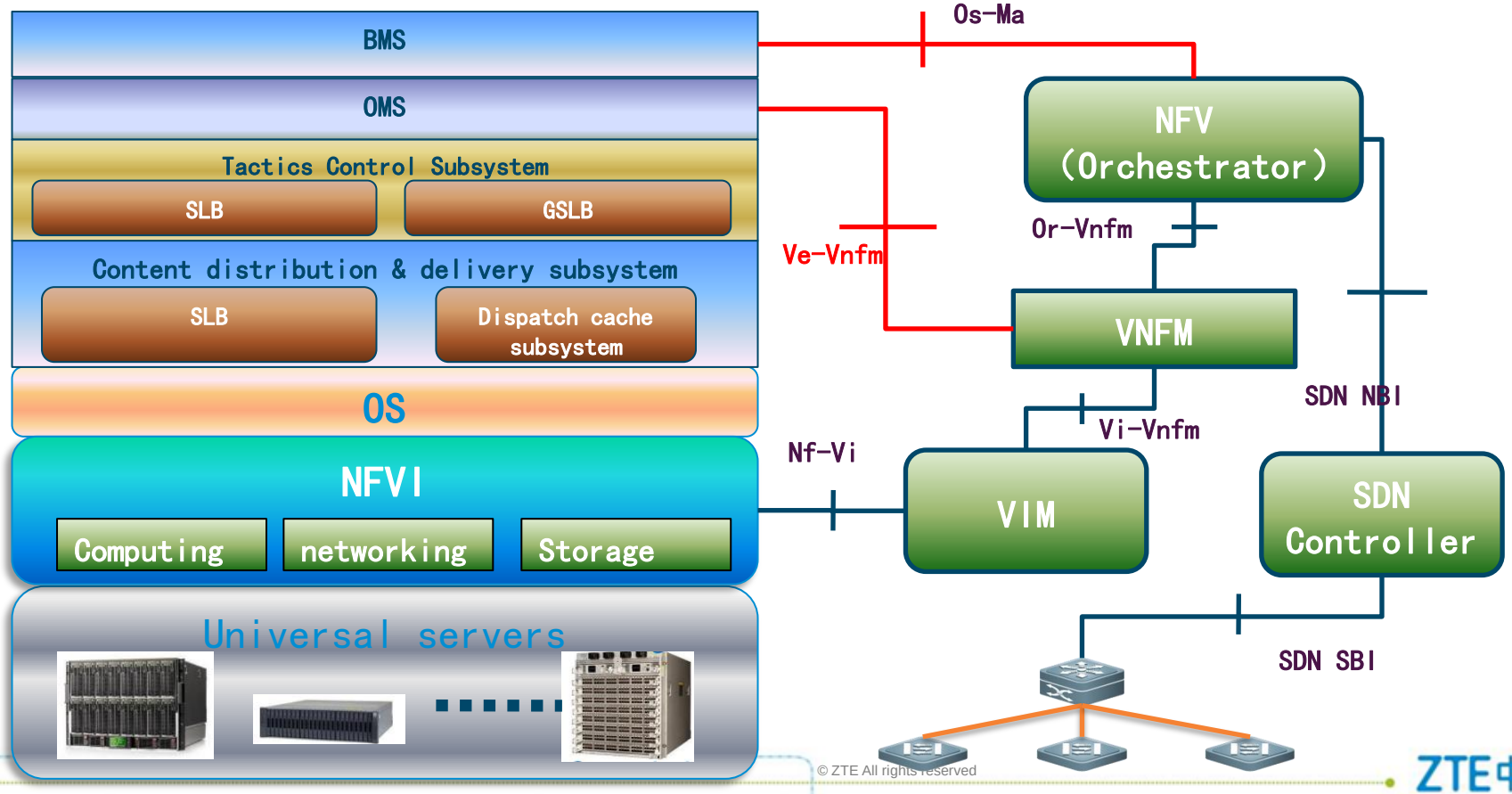
The Operator's problem

- Numerous/Various dedicated equipments, but short lifecycle
- Difficult new service development, long-term, high operating cost.
- New type of equipments required, difficult deployment, high investment.

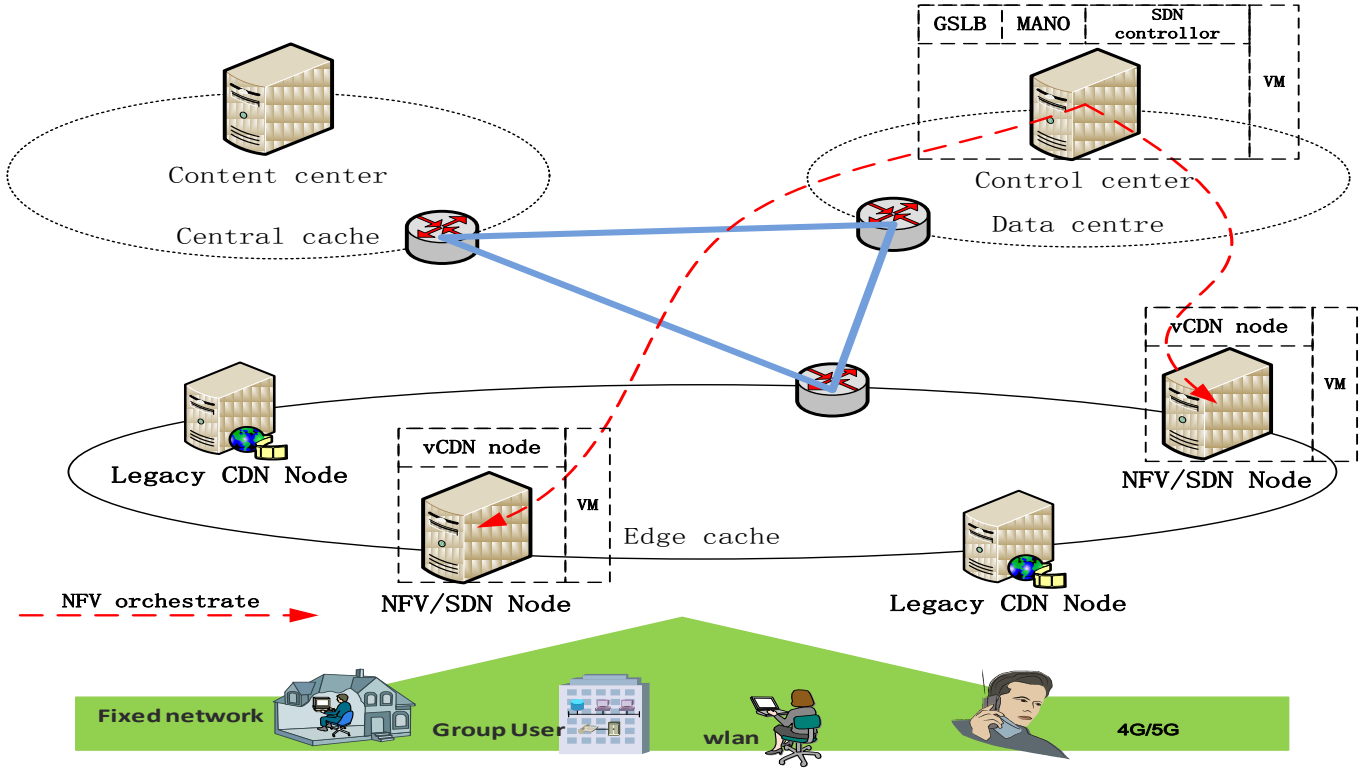
The target of NFV

- By through the virtualized service gateway and the unified hardware platform, NFV is able to quickly deploy service, improve efficient of management and maintenance, the fast new service development.

The virtualized CDN functional architecture



The networking of NFV/SDN-based vCDN nodes



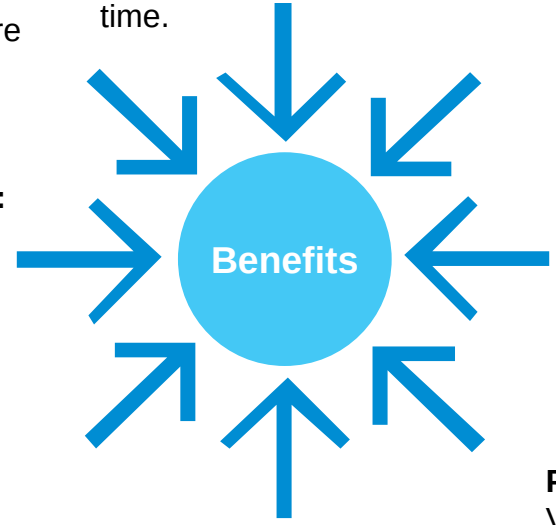
NFV&SDN-based CDN benefits

Visualized traffic：network elements and traffic can be easily observed. It can precisely position the trouble point where the bad performance is detected.

Traffic scheduling: maximum usage of traffic in the dimension of link and time.

The flexible VNF adaptation policy: the VNF scale can be adjusted based on the various factors, e.g. peak time, CPU loading, service requirements.

Network controlled by CDN services: the network traffic is controlled by SDN controller according to the CDN service requirement.



Quick and auto-deployment: the deployment of virtualized CDN nodes are much faster than traditional CDN nodes.

High efficient conf & maintain：An unified MANO system enables the management over multiple DCs.

Multiple customers: the unused computing, storage, networking resource can be rented to multiple customers.

Policy-based VNF self-recovery：if the CDN VNF is detected in trouble, it can be recovered easily based on the configuration policy.

谢谢！

5G 先锋