HUAWEI

The Smart Pipe for Video

Video Function Cloud

A Huawei White Paper by
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November, 2016

Business &
Network
Consulting

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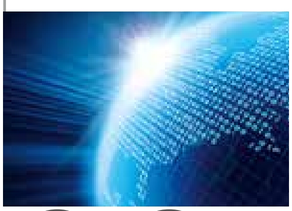


1 Background

Huawei's Video Function Cloud represents a next generation mechanism for handing Video on an IP network when operated by a Telecommunications Company.

The demands placed on modern IP networks by Video traffic are relentlessly increasing, and carriers must adapt to this increase in traffic, with both new infrastructure and new business models.

Video is no longer just about entertainment, it is becoming the core service to many applications, including communications, security, personal blogs, social networks and Internet of Things. As these services evolve, increasingly Carriers must adapt their infrastructure to cater for the various requirements imposed by these variable, and often unpredictable applications.

With this new “Big Video” era dawning, Video Function Cloud represents an adaptable fabric of video services and functions, which transform video from being “just data” on an IP network, to being a core billable and manageable service. For the Carrier, “Video is the new Voice”.

2 The problems and promises of Video.

Almost everyone in the telecommunications industry knows that more than 50% of all traffic on their network is now video.
Forecasts predict this increasing, and some suggest 80% by 2020.
The problem for the operators of the IP networks facing this reality, is that unless the user experience is going to suffer, they are almost obliged to increase network capacity to carry an ever increasing amount of video.
This may require heavy infrastructure investment and sometimes network re-design and consequential costs; but where are the revenues to support it? Most of the time, the carriers are not a part of the Video Value Chain, and hardly benefit commercially from the value of the video traffic flowing through their networks.
Fixed broadband revenues are typically fairly static based on market economics - yet bandwidth demands continue to grow. Mobile data charges often are in fierce competition between mobile operators, with prices per GB declining in real terms. Yet mobile video traffic continues to demand network investments.
Such are the problems with video.
Yet video also promises to differentiate IP networks over traditional broadcast TV delivery techniques, giving Carriers an advantage. New video formats such as 4K, 360 and VR are demanding ever higher network delivery performance. The whole IP video industry is booming, you can watch anything online now if you know where to look! Messaging apps now support high quality video calling, web sites are including video backgrounds instead of static ones, home surveillance is on the increase, video uploads are going exponential, and global OTT premium entertainment providers are becoming main stream.
So why is it that for many carriers the problems of video remain and the promises seem unreachable?

3 Transformation is required

To embrace “Big Video” and commercialise it, a traditional Carrier - typically focussed around usage based commodity telecommunications products such as voice, data and messaging - must undergo both a Technical and Commercial transformation.

Technically, they need products, components and infrastructure to be able to engage with and add value to the transit and consumption of video on their networks, and then they need the billable B2B and B2C service structure to commercialise it.

In short, Video needs to become core to the services the Carrier offers to both consumers and businesses, and also core to the architecture and capabilities of the network.

4 The need for a Smart Video Network

For a number of years, the sources of a large majority of Internet Video traffic have been fairly predictable. Large video portals such as youtube.com in the west, and local TV apps such as iPlayer in the UK have been predictable and large sources of video traffic.

The world-wide web started with the traffic focused on a small number of portal sites, but rapidly fragmented into discovery/search followed by a huge number of individual sites, which then gave way to peer-to-peer traffic, UGC and the Social “web2.0”.

In a similar way Video traffic patterns are changing. Rather than a small number of “Video Sources” and a large number of known and predictable “Video Sinks”, Video traffic on the Internet is rapidly changing into a “mesh” with everything from a mobile phone to a connected “thing” being either a source or a sink (or both) of Video.

IPTV and OTT entertainment and TV portals and services fall into category of “single source multiple sinks” topology, with predicable content, distribution paths, device types and consumption patterns.

As video over the Internet matures however, just as the web has matured, we are seeing the need for a new infrastructure that can:

1. Manage any connected device as a lossless source of video
2. Distribute video seamlessly, either point to point, or one to many - efficiently
3. Manage delivery to any number of new device types, with various protocol, packaging, security and resolution requirements seamlessly
4. Understand the popularity of content, and content duplication, and as such optimise network transmission techniques (such as multicast vs. unicast) dynamically
5. Use cache storage efficiently such that the need to process content and transmit content on the network is optimised.
6. Add services such as pause, playback, archive, splice and trick-play to any live stream.
7. Measure and monetize the services delivered.

Why is Video Function Cloud necessary for Carriers?

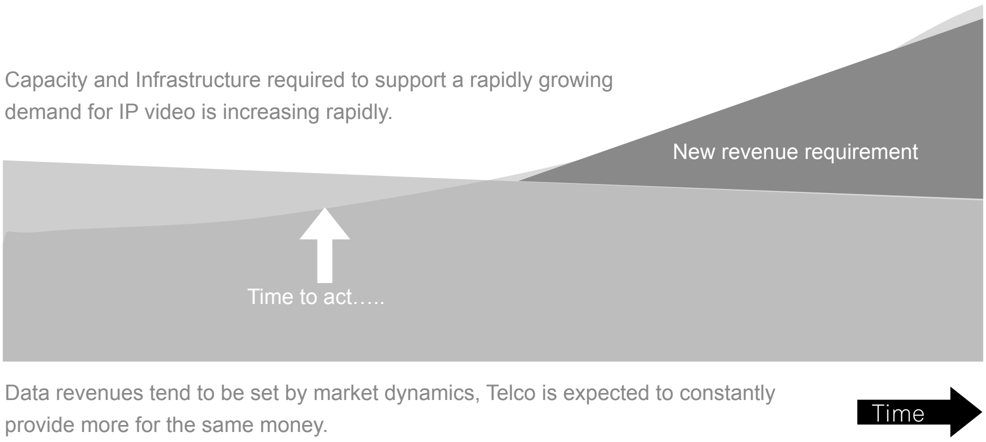
Carriers potentially face a revenue SHORTFALL as they need to continue to expand their capacity based on the increasing demands of Video Traffic.

The Carrier may launch their own premium video service, and if done right, it may be commercially successful; however, even a successful Carrier based video service will only represent a small percentage of the total video traffic on the network.

The commercialisation of video, via any known business model is in the $0.10 - $0.50 per hour viewed per unique user, this revenue stream is unlikely to be enough to cover the revenue short fall.

Capacity and Infrastructure required to support a rapidly growing demand for IP video is increasing rapidly.

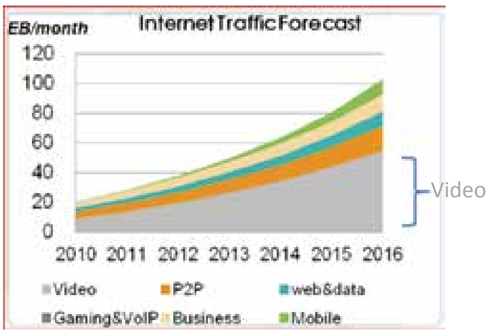
Costs associated with providing Capacity increase with video traffic



Revenues from providing a FBB or MBB data service, fixed or declining.

Data revenues tend to be set by market dynamics, Telco is expected to constantly provide more for the same money.

A necessity therefore for the Carrier is to be able to "get in" on the value chain of a larger proportion of all video flowing through the network.



We know that our networks are filling up with Video….

This video will not originate in a single known place and be distributed to known devices with clear capabilities, like a tree….

And however successful our TV strategy is ….
The majority of this video will not be OUR video…

High quality video will originate anywhere, and need to be distributed to anything… like a mesh…

Our networks cannot just treat this traffic as "data"… there are new opportunities for us to process, store, transform and stream this video in a more managed way…

What can a Carrier offer 3rd parties generating video traffic?

Fortunately the problems solved by VFC are actually generic to all video providers, whether they are live or on demand, entertainment or communications or verticals.

The demands to support new device types and new formats will make the task of reliable video distribution more demanding not less. Ultra HD formats such as 4K and 360 place great demands on the network to deliver with any consistency, and the increased complexity of Video Sources and Video Sinks, make the problem unmanageable for all but the largest and best resourced 3rd parties.

As well as the problems surrounding the distribution of new video sources and supporting new devices or Video Sinks, comes additional problems such as security and archiving, that will become necessary for video generated by IoT or non-human devices. The complexity and demands of uploads rather than downloads presents a significant opportunity for the Carrier to offer B2C and B2B products to the industry.

Video uploads are “originals” and should not suffer loss or interruption of any kind. A high quality of live stream uploading, must by necessity be guaranteed in some way by the Carrier, and supported by infrastructure that is close to the edge of the network.

Video Function Cloud’s capability to “distribute ingest” and “record on demand” make it a very powerful platform to roll out new video services and business models.

As such, VFC and the intelligence it adds to the core networking capability of the Carrier represent the infrastructure for commercializing Big Video.

5 CDNs are not smart enough

5.1 Understanding traditional CDNs

The theory behind traditional CDN’s is fairly easy to understand. Whether a CDN is accelerating access to a web site, or helping deliver video, the principle is the same. CDNs attempt to separate the static and dynamic parts of Internet responses, and serve these separately.

CDN technologies identify the “static” (unchanging) components of a response, as opposed to the dynamically generated response structure and then re-direct the requests for the static components to new servers located much closer to the final user.

The dynamic content, such as a personalised page structure or a list of watched videos, will typically be generated by the origin, but it will refer to static objects such as images, video chunks or standard libraries, objects which are typically common to all user responses. By storing and serving these locally, the origin and intermediate network are both saved the load of serving and transporting these identical resources over and over again.

CDN technology is fundamental today as it allows consumers to be confident in the performance of web sites and OTT video. Many believe that without CDN technologies, it’s likely that the web and OTT video in particular, would have become completely unreliable, and it would not enjoy the level of consumer confidence it has today.

For video delivery, the traditional assumption was to treat the video asset (or chunks of it) as static files (assets) which never really change once they have been provisioned. The goal of the video CDN therefore is to take these static assets and serve them to requesting devices from infrastructure close to the requesting device.

These "edge" based CDN's theoretically keep copies of the assets, and the "intelligence" in the CDN really boils down to keeping track of these stored assets and routing requests for them to a server which results in the lowest network load end-to-end for the content publisher.

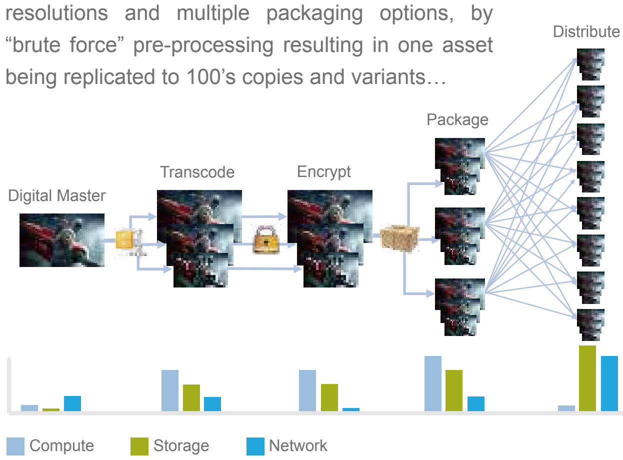
If every video was simply made up of a single set of static assets or chunks, this approach would work fine.

5.2 Not all Video is the same

The resolution, compression, format and packaging of video dramatically changes the storage requirements for the video and the network bandwidth needed to stream it.

To cater for all types of devices (different resolutions), on various different types of network (different bitrates), and from different manufacturers (different security and streaming protocols), we find that multiple different versions of an original video need to be prepared to be ready for all eventualities.

Typically need to support for multiple DRMs multiple resolutions and multiple packaging options, by "brute force" pre-processing resulting in one asset being replicated to 100's copies and variants…



Traditional CDNs, when used for video, optimises Network resources at the expense of Processing and Storage Resources

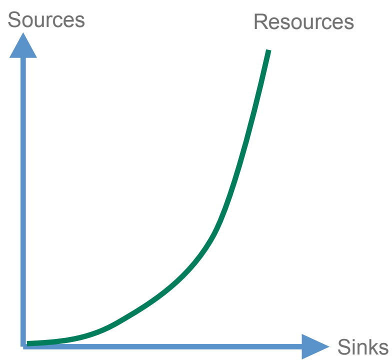
A single Video on Demand asset can quickly multiply into a large number of “copies” – each pre-processed into different formats, different packaging options and different encryption technologies. For example an original Movie asset, delivered in 6 resolutions, 3 DRMs and 2 packaging formats needs to be pre-processed into 6*3*2 different combinations resulting in 36 different copies of the movie needing to be cached.

The traditional model, uses large amounts of pure processing power, once, to generate all the versions, and then uses large amounts of storage to keep them, (often in multiple places) ready for delivery.

Traditional CDNs therefore are only designed to optimise network efficiency, and do so at the expense of processing and storage efficiency.

This is still often a good strategy, when there is:

- a predictable library of assets
- being consumed by a predictable set of devices,
- in a known set of locations
- from a single known source



However if the whole library is suddenly refreshed, or if just one new type of device triggers a requirement for a new resolution, then a huge storage and processing effort is suddenly required for this simple change.

These situations are common, libraries of content do refresh as they are often rented for a period of time, and new types of devices are becoming available often.

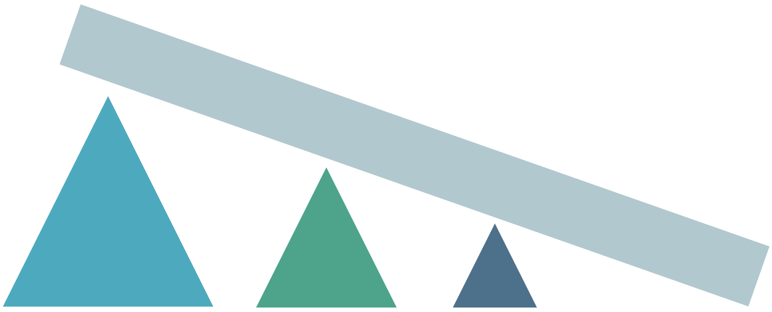
5.3 Sources, Sinks and Complexity.

In the real world the number of sources of video is multiplying and includes:

- security cameras,
- published video assets,
- live TV channels,
- live bloggers and gamers
- drones,
- cloud storage services
- smartphone cameras

Meanwhile the number of sinks for video is also multiplying, and includes:

Typical relative resource profile for a frequently changing.
VoD library with known popular content



- Smartphones
- tablets,
- set-top boxes,
- connected TVs
- smart watches
- video broadcasting services,
- video archiving or storage services
- video analysis services

With the traditional CDN approach to the problem, as the number of source and sinks expands, the complexity results in an exponential growth of required storage and processing resources. These problem cannot simply be ignored in the planning of a Content Delivery architecture.

5.4 Video on demand is not the only use-case

Video on Demand services are well supported by the traditional CDN architecture. The delivery of live TV streams, however, and the provision of services such as recording, pause, resume or device shifting on this live streams, put a completely different set of requirements on a Content Delivery Network.
For IPTV services, additional functions such as Forward Error Correction (FEC), Fast Channel Change (FCC) and Multicast to Unicast stream conversion and buffer storage are added to provide a good experience around live TV. As with traditional CDN services, these additional services are best located close to the edge, where they are able to respond to the network conditions and demands of client devices.
For OTT live streaming services, great stress can be added to an

end-to-end network, if multiple unicast streams are required to be transported long distances, with little or no chance of predicting the content, or storing and caching it. These demands again require additional new functions to be delivered close to the edge of the network, and near the requesting user.

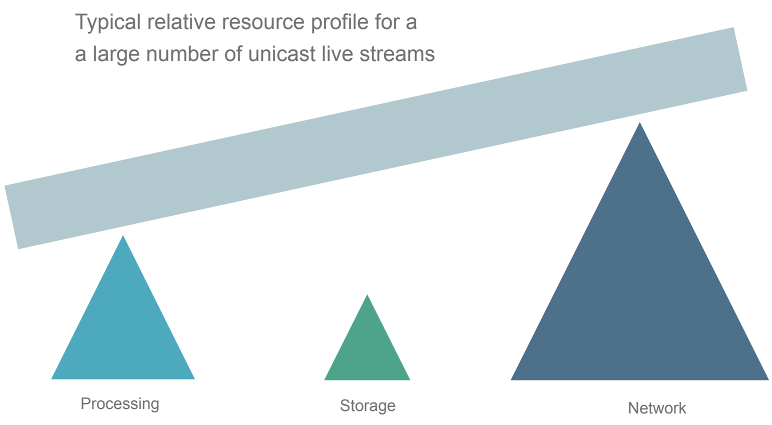
> The trend we see as we examine these new application areas, is that new applications often need new video processing functions and services to be provisioned, quickly and dynamically, close to the edge of the network.

5.5 New Services new demands

Live Streams

Consumers are beginning to use video in new ways. For example many have enjoyed the amazing success of Twitch.tv, where gamers, often sitting at home on their XBOX or PlayStation games machines, are watched by literally thousands of concurrent users live. These top gamers are the new sports athletes for the millennials.

The concept that a "live TV Channel source" could come from an individual, is also a use case that extends to a number of current applications, including:



- Facebook video "go live"
- YouTube "live streams"
- Traditional live streaming apps such as Periscope and LiveStream

The rise of these UGC or Machine generated live streams for entertainment or mass market viewing also creates new demands on the user interfaces for the traditional "EPG". The channel line-up is simply not a constant anymore.

Each of these streams would benefit from network services such as archiving, Time Shift, Catch-up and user controlled recording.

Multiple VoD Libraries

Video On demand libraries are also changing. Gone are the days when a TV operator simply hosts their own licenced content.

Various well-known brands will build their own Apps to host their libraries, but having "silos of content" locked away in heavy apps, each with their own UX and content discovery tools is not the best solution for end users or the TV operator when acting as a super aggregator.

The total amount of video on demand content that can super-aggregated in a TV Operator app today comes from a wide range of sources as detailed in the Table below:

Type of 3rd Party	Typical Number Integrated	Typical Integration Method	Number of (Premium) Assets	Examples
Large Brand VoD Libraries	3-12	Native Application Launch, with some assets "deep-linked"	100-10,000	Netflix, YouTube, iPlayer, HuLu etc
Medium Size Apps	10-100	Web Application embedded in Frame. All or most assets deep linked. Or play inside branded template configured by host operator. Assets typically played from 3rd party CDN	1000-10000	TED Talks, Khan Academy, Sky news, etc.
Direct Content Publishers	100-50,000	Assets and/or metadata uploaded to hosted infrastructure, Templated playback, Carrier CMS used for UX. Carrier CDN or 3rd party used depending on whether Asset uploaded. CP Controlled branding, features and functions in Template.	100-2000	Niche sports archives, Self-published Studios, Specialist Content, International libraries. Local content etc.

A key problem arises when a Carrier needs to present video content that originates from 3rd party origin servers. How can compatibility be assured between the origin and all the device types that the Carrier wants and needs to serve?

This large requirement again demands the capability in the Smart network to transform and process video before delivery. In fact the carrier's ability to do so greatly simplifies and adds value to the Carrier's partnership with the 3rd party VoD provider, bringing greater opportunities for revenue sharing or B2B service charging.

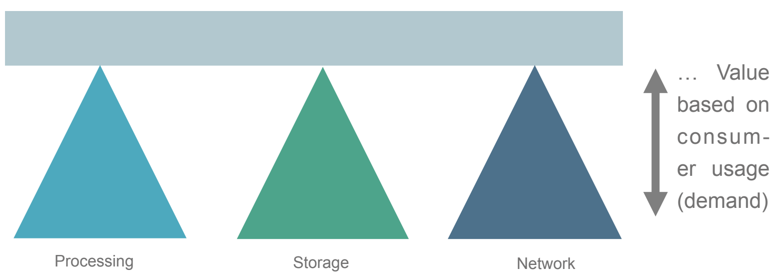
For both live streams and video-on-demand services therefore, we have seen how new video service structures present new demands on a media delivery infrastructure and the benefits to the Carrier to have a core network capable of smart video processing.

6 Video Function Cloud: Enabling the Smart Pipe.

6.1 Network capability evolution.

In recent years, we have seen a flattening of core network architectures, and a move towards Network Function Virtualisation (NFV) and Software Defined Networks (SDN).
In fact IP data networks are already becoming smarter.
In addition the Data Centres are increasingly running the algorithms and functions necessary for the operation of a smart IP data network, and the management of all the key elements in it.
The carrier benefits from an increase in the agility to define and roll out new network features and functions, and a greater level of flexibility in the coordination of their network resources.
As such the integration of Video processing functions into the core network fabric of a carrier is a natural evolution of functionality for the network.

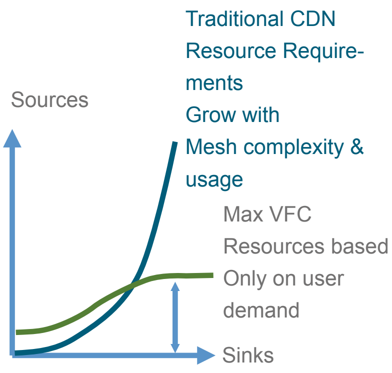
Ideal optimised resource profile for all use cases.



Massive scale and efficiencies in data center storage and processing capabilities also under-pin the capabilities to perform the "heavy lifting" necessary to process video dynamically.

An intelligent video distribution fabric should be capable of intelligently balancing network, processing and storage resources based on demand for the consumption and transit requirements of video traffic.

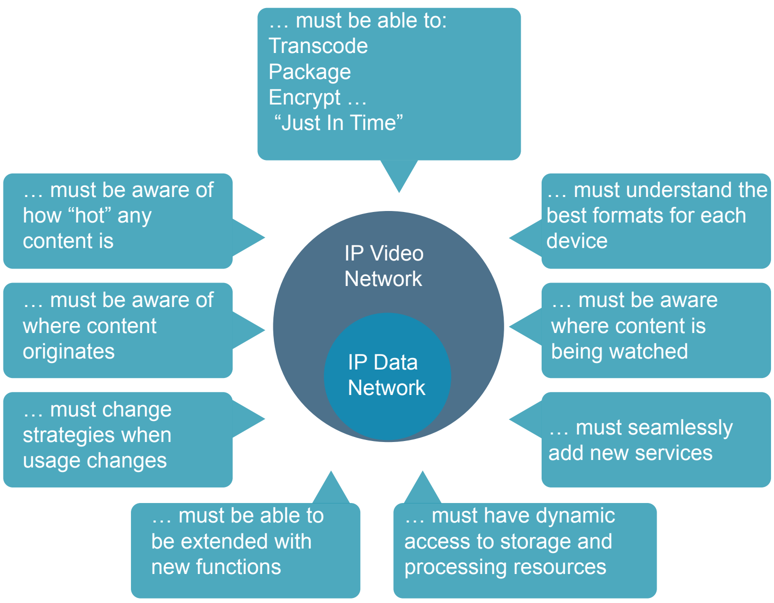
Overall as the complexity of sources and sinks for video grows, this approach becomes actually becomes more efficient that any traditional CDN architecture, which copes badly with changes in the profiles of devices, and also dynamic changes to the libraries and live streams integrated.



6.2 Initial requirements

The requirement therefore fundamentally comes down to an intelligent video processing fabric that is closely integrated with the core network infrastructure of the Carrier. The fabric is capable of performing “services” on video connections, thereby adding value in terms of device compatibility, security, QoS or end user features and experience.

In order to perform these services, the fabric has certain requirements. These can be summarised as follows:



6.3 The VFC Concept

Huawei’s Video Function Cloud concept is already in trial and proof of concept with a major western carrier.

In its initial implementation, it was given the challenge of replacing the time shift TV, catch-up TV and network PVR functionality of a centralised Entertainment Platform, with capabilities regionalised and in the cloud.

To implement this, lower level functions, of Just in Time Transcoding (JITT), Just in Time Packaging (JITP), and JITE (Just in Time Encryption), were implemented alongside storage, streaming and ingest services. The lower level functions were orchestrated to deliver the higher level services.

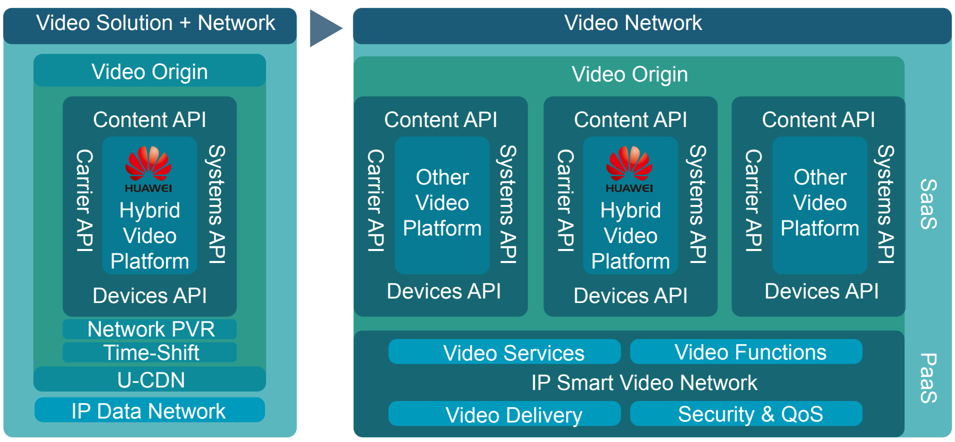
A number of HD, DASH input streams were configured as live TV channels. The VFC configuration was able to store a single buffer of this stream, in its original format. As requests were received from different device types, needing different resolutions and packaging (for example packaged HLS with three different bitrates/resolutions) the VFC instance was able to process the video dynamically for the end user request.

Changes to typical Video Platform architectures

The functions to process and prepare video, as well as stream it and deliver it to end devices in the right formats, was typically part of a video platform solution.

However, VFC represents a de-coupling of the Video Service Platform (which controls all business logic and user interaction capability, as well as apps) and the Video Function Infrastructure, which manages the dynamic transformation and management of video as a medium.

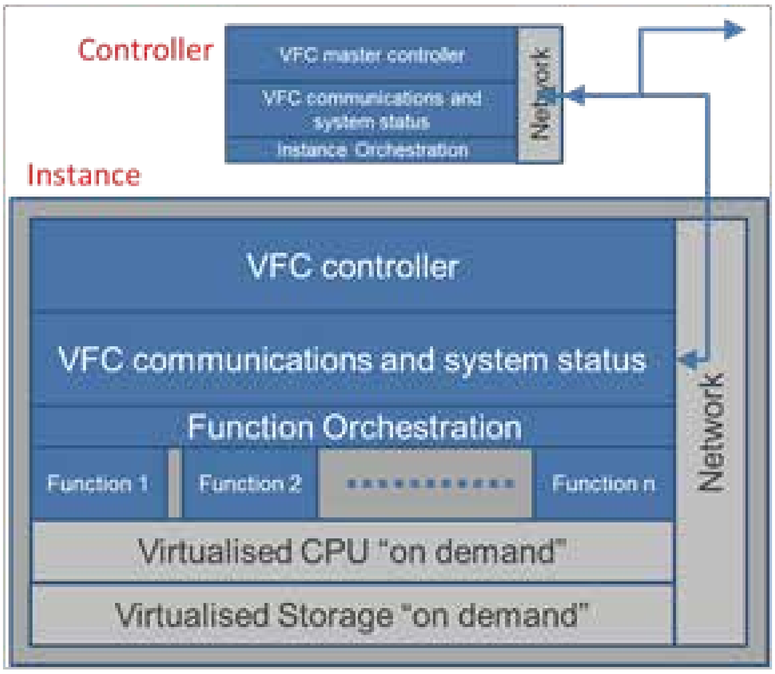
As such the Video Function Cloud would exist as part of a Platform as a Service (PaaS) offering, while the Hybrid Video Platform (Huawei's TV and video software solution) would exist as part of a Software as a Service (SaaS) offering.



Live pause, time-shift TV, Catch-up asset requests and nPVR recordings were all implemented as dynamic requests against a single storage buffer holding the original format.

As more devices accessed the same format /resolution/ time-slice requests, the VFC automatically switched to serving cached chunks of the video, saving processing time from the original.

As content became cold, storage could easily be optimised without consequence, as non-cached content requests could always be provisioned dynamically. This architecture greatly simplified the integration between the centralised Video Platform and any regional deployment locations because only a single master stream needs to be ingested and therefore distributed regionally.



It was proven by modelling that the system would scale more efficiently that traditional systems because the final level of resources required depends on activity rather than complexity. Single end user performance was determined to be acceptable and hardly distinguishable from traditional models.

6.4 Video Function Cloud Roadmap

The VFC proof of concepts that have already been deployed and tested have proven the benefits of just-in-time video processed & orchestrated into a set of higher level functions with dynamic access to processing and storage.

Migrating video transiting the network to such services using B2B relationships for the services, and B2C portals, billing and components will allow the Carrier to transform the flood of data on their network caused by video, into a valuable set of services and capabilities.

The VFC Roadmap should direct it at becoming the "Video Switch" at the heart of a Big Video Ecosystem. Essentially transforming the "Dumb Pipe" into a "Smart Pipe" for video.

In order to achieve this, the VFC instances must work together coordinated by an overall domain controller, and video source and sink requests should be made via scalable and standardised APIs.

The roadmap should therefore include:

Functionality	Description	Commercial benefit
Cloud Native	Ability to Scale UP/Down elastically based on demand	Offers true virtualisation across both Public and Private cloud
Standard APIs	Ability to integrate with any Video Platform, Including for example, Kaltura and Huawei and other 3rd parties	Standardisation will allow support from 3rd parties, including IPTV vendors and OTT applications
Public APIs	Will allow “self-service” integration of video sources from 3rd parties, including live TV, VoD and communications applications	Will offer enhancement to Entertainment, Communications and Verticals
Controller Hierarchy	Will extract key controller functions to separate instance, allowing coordination of resources across multiple VFC instances	Scalability, will allow multiple VFC instances to work as a single system, and allow single point of integration across all instances, saving Operations and Maintenance efforts
Service & Function Configuration	Will allow dynamic addition of low level functions, and high level orchestrated services.	Fast TTM with new innovations and configuration changes
Expansion of Standard Services	Over time, new types of services, including JITE for all the major DRM providers, different packaging and ingest options, and new format support will be added.	Allows VFC to continue to evolve to meet industry needs.
CDR Support	Will allow integration with legacy billing systems.	Standard interface legacy Billing Systems, provides interoperability.
BSS and BES integration	Will allow Carrier Billing for services, both B2C and B2B.	Allows revenue share with 3rd parties, allowing them to deploy premium video services, and share in Carrier based subscription revenue based on USAGE.

7 Could Video be the new Voice?

To conclude this white paper on Video Function Cloud, we should look a little more to the future.

It's clear that for a Carrier to make up its potential revenue shortfalls in supporting the growing quantity of video traffic, that they should become the heart of a Video Eco-system, with Video Processing and distribution as the Core service they offer both B2B and B2C.

Brainstorm of potential carrier video "Value add"

Immediate	Mid Term	Long Term
·Drive Traffic through: ·Content Discovery ·Personalisation ·Social Networks ·Host and deploy video assets ·Provide Templates "shops" for 3rd parties ·Apps Store ·Create "data free" Video Products on mobile ·4K Delivery ·TSTV, nPVR and other services for live channels ·Revenue generation thru Ads and Payments	·Efficient delivery of any type of live stream ·Processing functions on any type of live stream ·Archive, Pause, etc ·Dynamic Stream and Asset processing: ·JITT, JITP, JITE, Cache ·HQ Video Uploads ·V-MOS Guarantees ·Device Bit-Rate Adaption ·Push content on mobile ·360 Video delivery and processing ·Metadata Enrichment	·Mobile Live Stream uploads ·"Video Life" Archiving ·Video Archive Indexing ·AR/VR Generation ·Massive Tele-Presence ·Video Calling enhancement for OTT services ·Security and Surveillance as a service ·Video based IoT ·Full Video Switch/-Fabric

Opportunities to commercialize this capability abound.

A whole range of chargeable video services can be imagined, both as consumer services and business services.

As new services are imagined, we should consider the parallels between the telco's original Business Model, (that of delivering Voice Services), and the characteristics of a the new ecosystem where they may be delivering Video Services.

There are a number of Stark parallels:

7.1 Video Centric Billing (Time based billing for video)

Voice communication used to be billed based on the length (of time) of the call. This was because voice switch resources were occupied during the call and freed up once the call ended.

What is Video Centric Billing?

The Problem (Customer View):
·Customer x wants to watch a Movie using the mobile network.
·He buys 1Gb data:
·On a GOOD part of the network he runs out of data before the end of the movie…
·On a BAD part of the network, he can watch 2 movies for same price!

The Problem (Carrier View):
·Video viewing on ABR ramps up to saturate network capacity.
·If Carrier optimises video delivery using HEVC, or profile squeezing, customer spends less on data, and generates lower revenues
·No incentive for network optimisation for 3rd parties

Data Centric

Currency: MB or GB
Validity Time: 1 day, 7 day, 28 day
Type: 2G, 3G, 4G
Price: On peak / Off Peak

Customer buys a data product that fits their usage pattern.. But has "Data Anxiety" while watching video…

Video Centric

Currency: Viewing Time (Hours)
Validity Time: 1 Day, 7 day, 28 day,
Type: Low, SD, HD, Upload
Price: On peak / Off peak

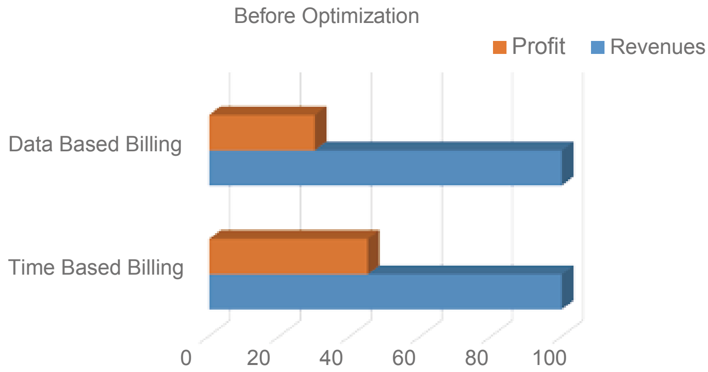
Customer buys "Viewing Time" at a particular quality, Has "NO Data Anxiety" while watching video…

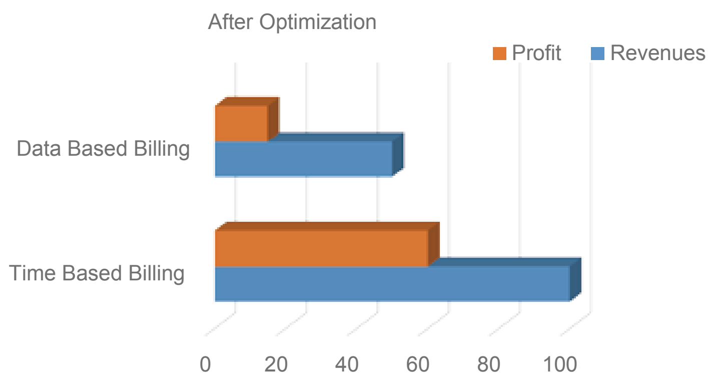
The logical "currency", to sell entertainment services, TV viewing, and even broadcasting quality uploads is by "time". We could see a day soon when Mobile Carriers include a "Video Hour" (as a time based product) as a bundled feature with various packages, allowing a certain amount of "time" when video viewing of various services would not incur mobile data charges.

The "time" would have a "value" and be sold separately, but unlike selling "data" to watch video, selling "time" allows network resources to become more efficient (using less data for the same time) while preserving revenues. If video is made more efficient when delivered to end users, and the end users are buying data, then the potential profit is passed onto the end users; as they

need to buy less data for the same time watching.
This acts as a disincentive to Carriers to move to more efficient codecs or delivery models (like multi-cast) as it potentially reduces data revenues, essentially passing the cost saving through to the end user in reduced data purchase requirements.

Effect of optimising data needed for video delivery by 50%





Consumers generally appreciate the value of Video as the amount of time they are being entertained, or otherwise engaged, in the video product.
As such they are willing to pay the same regardless of the delivery technology. When considered like this, it makes no sense to be selling "data" to end users, when the primary purpose of buying that data is to watch TV or online Video.
Here's 7 reasons to move to time based billing for video on metered networks (mobile):

1. Time RATHER than Data is the logical "currency" for metering video consumption on mobile networks
2. Consumers want to know how much time they have to

watch video, from a few hours a month to unlimited (like Binge On from T Mobile)

3.Carriers can sell "Video Hours" applicable to their portal and partner 3rd party publishers, creating an ecosystem, as they pay for the TIME and the DATA is then free.

4.Removing "data anxiety" for consumers watching video increased engagement time with video and commitment to the Carrier properties and brands

5.Time is "Value" for consumers, then as Carriers become more efficient in delivering video (new CODECS, CDN etc) there is less DATA for the same TIME, creating PROFIT

6.Not all Time can be the same, e.g SD Hours, HD Hours, Off Peak Hours, Peak Hours at different price points, etc, providing a variety of "products" the Carrier can sell the consumer can "top-up" , moving them strategically to selling VALUE based VIDEO products rather than commodity metered products like DATA.

7.Example: customer buys 1Gb to watch a movie, on a GOOD network he runs out of data, (as the resolution adapts and gears up using more), on a BAD network he watches the whole movie in SD and has data to spare…. Does not makes sense.

As such both Voice and Video have in common the need for Time Based billing.

7.2 The need for a "Switch".

Voice communications would not be possible without a "Switch", network equipment able to take the call request initiated by one device, resolve that to a route to another device, and, ensuring compatibility and quality, deliver the voice between the two end-points for a given time.

The "Switch" as such is the core technology component enabling the Voice business model.

Like a switch, Video Function Cloud provides the core component in efficiently connecting a given Video Source to a given Video Sink. Just like a switch, an infrastructure investment will be needed to enable the new services. The core network must be "upgraded" to a Smart Video Network by including the Infrastructure required to process and transform the video (if required) to ensure QoS and compatibility between the parties involved.

Like “voice mail” addition services such as “stream recording” can easily be added to the basic transport and compatibility level services.
As such, both the Voice and Video business models have in common a requirement for an infrastructure level processing component to enable it.

7.3 Ecosystem model with high growth.

Voice was an ecosystem. The Carrier rarely generated calls for themselves, or “owned” the call content. Instead Callers simply connected when they needed to talk. The more people (devices) connected to a carrier, the more useful the ecosystem, and the more it was used. Growth was naturally exponential.
Likewise adding value, delivering and processing 3rd party video, or even user generated video streams has the potential to become and exponentially growing ecosystem. As such the carrier does not need to licence or buy its own content to monetize the majority of video on their network.

7.4 Interoperability with other Carriers.

Voice has the advantage over video when it comes to calling people on 3rd party networks. Standards exist to connect the switches of different Carriers and carry voice to any party in the world.
If Video Function Cloud was installed only in a single Carrier, then inter-carrier interoperability could not initially be guaranteed.
However a key initial objective of VFC being installed in a Carrier, is to differentiate the Video services on one Carrier over another. If Video works better for consumers on one carrier, then consumers are more likely to subscribe on that network, and churn will be reduced.
For example if data free viewing was only available on Mobile Carrier A, then it would attract subscribers and reduce churn. If video calling in a 3rd party app such as wechat or WhatsApp was free of data costs for a number of hours a month, when calling friends on the same network, this would act as an attractor for people to recommend the network to others.
If interoperability was required because of the B2B side of the

eco-system, a number of solutions exist:

1.Huawei could operate a hosted VFC Infrastructure with the ability for Content Providers to register to deliver services across multiple carriers. The Huawei instances of VFC would then interface to the different Carriers as a “root controller”

2.Standards may emerge, de-facto rather than ratified, if Huawei was to publish APIs, to allow Carriers to integrate directly

3.Eventually compatible VFC solutions may appear from a number of vendors.

The exact requirements for interoperability between carriers will become clear as this concept becomes more wide-spread.

8 Conclusions

Video Function Cloud represents and exciting and necessary evolution in Huawei’s capabilities to help Carrier Customers monetise and manage Video on their networks.

B2B Services	Big Slice – Small Pie	B2C Services
Discovery and Monitisation: ·Live TV Channels, ·3rd Party VoD uploads ·Traffic & Revenue Share ·Opt In Ad serving solutions ·Apps Store ·CP Templates ·UGC Uploads for businesses ·Metadata	Portal Content Discovery, Personalisation, SNS, Rights Management,Recommendations, Metadata Enrichment, Cast/Crew EPG, App Store, CP Templates, Analytics, Billing, Ad Insertion, etc Huawei Solution: Hybrid Video Platform	Mobile TV portal + STB and In Home TV Service: ·Global Search and Discovery ·Personalisation ·Billing ·Multi-Screen interoperability ·NGTV Features ·Live TV + VoD + Apps and 3rd Parties ·Video Calling
Distribution and Optimisation: ·CDN Services ·Content Security Services ·Multi-cast / unicast transformation ·Live TV Channel ingestion ·Point to Point Video distribution ·Live Stream uploads ·Stream and Asset transformation	Process Multicast, Unicast, JITP, JITT, JITE, Format Conversion, □Ingest, Stream, nPVR, Time Shift, Archive, Catch-Up, Encode, Elastic Infrastructure Huawei Solution: Video Function Cloud + DC	Ensures better quality video experience ·Live TV Streams ·nPVR, Time Shift ·CDN serves assets quicky ·IPTV channels ·4K & new formats enabled (360 etc) ·Good experience with 3rd parties ·Video uploading, archiving & strreams
Internet services: ·IP Routing and delivery ·DNS and Hosting ·Interconnect ·3rd Party CDN server hosting ·Data Center services ·Cloud Service Management	Pipe IP, Data Routing, Low latency, High Throughput, Transparent Cache, Traditional CDN Huawei Solution: IP Network Components	Generic broadband experience (MBB & FBB) ·High Bandwidth ·Low Latency ·Good Interconnects ·Zero Tariff data for some Video traffic on mobile ·Bundle with voice, messaging etc

It enables a missing layer in an ecosystem of video services that can allow the Carrier to offer B2B and B2C services, and both a Portal and now at a Process level. These services are not limited to content that is included in the carrier portal, but can also include video processing services which are transparent to the end user but are involved in 3rd party apps and services.

Commercial Implications of a Smart Video ecosystem

Video becomes the new Voice	The Carrier becomes the key enabler
·Consumers no longer buy "data to get video", instead: ·They subscribe to, or buy video services ·Prices and Services vary depending on the type of Video content, e.g. ·Unlimited "TV hours" on Fixed networks ·Metered "TV hours" on Mobile Networks ·"By the minute" charging for HQ live uploads and broadcasting ·Storage, Security and QoS options ·Etc.	·The Carrier holds important centralised content metadata ·The Carrier holds "big data" on video usage and behaviour ·Video functions and distribution become key carrier differentiators ·Revenue streams balance between B2B and B2C ·Carrier operated video portals become essential

Billing for these services can be based on the services provided, allowing a range of different video based products to be derived and sold by the carrier.

It expands the business video ecosystem from just "Portal and Pipe", to Portal, Pipe and PROCESS, as follows:

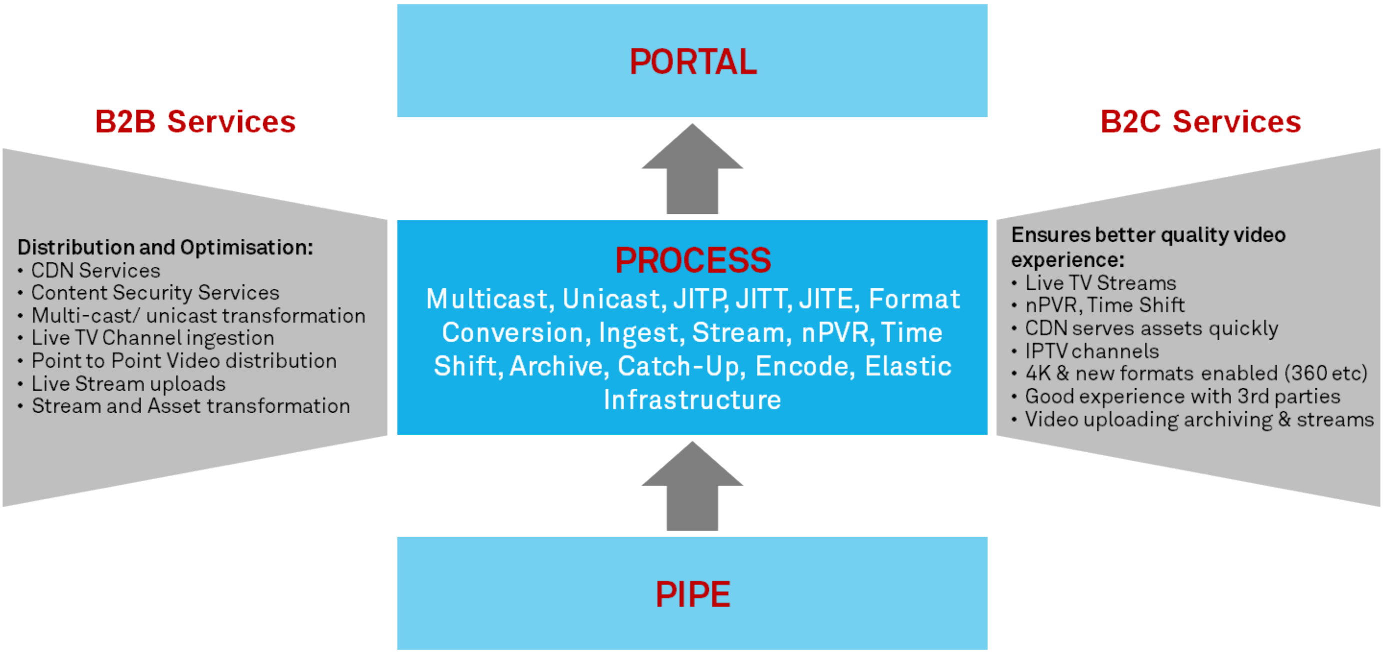
Having this additional "process layer", available to the carrier establishes the Carrier with some very important value in the ecosystem including, metadata, analytics, and unique functional capabilities.

It reinforces and establishes the need for the carrier portals, as well as balancing and expanding revenue opportunities.

The "Process Layer" in the ecosystem encourages video to migrate upwards towards the Carrier Portal, not only providing additional eco-system value and revenues, but increasing the value of the carrier Portal, which becomes a "mall" rather than a "shop".

VFC enables a "dynamic mesh" of video services, with various billing options, including time based billing, to any party needing it, whether part of or not part of the Carrier Portal, it expands the capability of the Carrier to monetise video flowing through their network.

As such it provides a conduit for video services which were previously only seen as data, to migrate up the value chain and quite possibly be incorporated into the Carrier Portal, increasing both the "slice" of the value that is available to the carrier, AND the size of the overall "pie" or market that they are involved with.



9 About the Author

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With nearly 20 years of experience in the Pay TV and Internet Video industries, Ian is known for inventing the "Red Button" interactive TV technology for Sky, publishing over 8 Video related Patents two ETSI standards, as well as being a founding member of Sky's R&D steering group. He now advises Huawei customers on TV Strategy and Product.