

Into the 3rd Generation of Video: Cloud TV

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Speaker Background Notes

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Presentation Outline

- 1. 3rd Generation TV--Overview
- 2. Media Industry Structure of 3rd Generation TV
 - Content Creators
 - Content Online Aggregators
 - Cloud Platforms
 - Content Distribution Networks
 - Internet Service Providers/Transmission Networks
 - Consumer Devices
- 3. Policy and Societal Issues of 3rd Generation TV

- This presentation is about television.
- But it is really much more than that
- There are few questions with more long-term implications than the way we shape our communications system.
- If the medium is indeed the message, and if these messages influence people and institutions, then tomorrow's media, and today's media policies, will govern future society, culture, and economy.

- It is therefore important to understand that we are on the verge of one of humanity's greatest leaps in media communications, and consequently also of one of its major disruptions of social, cultural, and economic arrangements.

- Television has come a long way, and has an even longer way to go.
- What runs through its history is myopia.
- In each of its generations, most users did not perceive a need for anything more advanced than they already had.
- And in each of these generations people did not expect the impact of the new medium when it emerged -- by a wide margin.

- If Moore's law is a rate of change of about 40% a year for the IT sector, then the what we can call Sarnoff's 2nd law, after David Sarnoff, head of RCA for decades, would be about 4% per year. x

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- TV has been around as a mass consumer product for about 70 years. That's over 30 years per generation. This is a glacial pace.
- TV sets from almost 70 years ago would still work in most countries.
- In those 65-70 years, the bit rate has increased, if we are generous, by a factor of 12. That's a CAGR of 4%.

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- This was possible, because the intermediary distribution systems controlled the technology that could display what came out of the pipe,
- and the content that went into the pipe.
- And the protocols under which such content could be coded or modulated or whatever was done to it.
- These were TV broadcasters, were also internationally organized through various collaborative cartel arrangements such as EBU or ITU. Their impact was to harmonize & standardize & stabilize

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- And on the consumer end, the hardware the terminal devices were almost interchangeable TV sets,
- Manufactured by a few large consumer electronics firms or brands like Sony and Philips and Thomson.

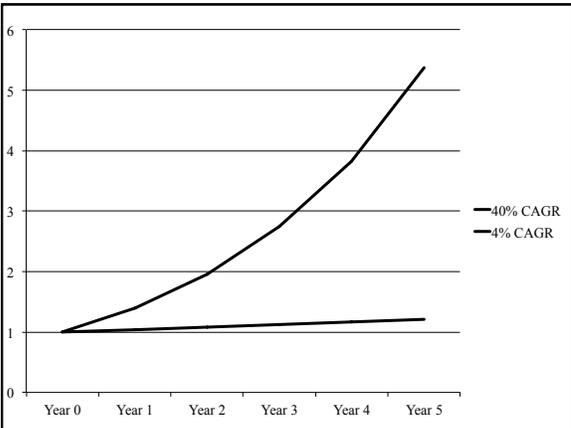
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- And as TV is migrating to the internet, it is moving away from the control of the traditional broadcast organizations, and into a new territory. Companies like YouTube and Netflix
- this has of course been widely noted.
- But one would make a real big mistake to think of the change as only one of adding another distribution platform for pretty much the same stuff.

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- But that is only part of the change, and arguably the less important one.
- More important is that we have to think through what it means for TV to move away from Sarnoff's Rate to Moore's Rate.
- From 4% to 40% CAGR.
- From a stable broadcast medium
- To a dynamic high tech medium

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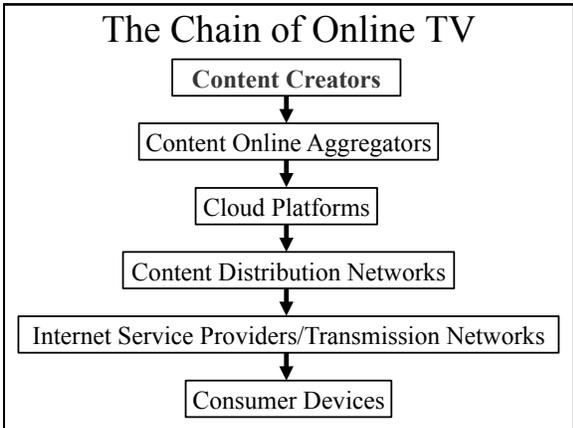


- So if the medium is the message, then if the medium changes more rapidly, then the message changes more rapidly.
 - This is what I would call “cultural acceleration”
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- How do societies handle this?
- Badly, if the past is a guide to the future. Cultural conservatism is deeply ingrained.
- Most individuals like the foods we grew up with, the music we courted to, and the ideas we encountered at home or in college.
- Societies are even more conservative, extolling its classic heroes of literature, poetry, arts, and music. Change was accepted but it had to be gradual.
- But now the pace is accelerating. Inevitably this creates cultural conflicts. In the 1960s we encountered similar cultural dissonances when “youth culture” broke out creating conflicts that are still reverberating 50 years later.

- Then, the change was precipitated by the emerging broadcast TV medium with which that generation had grown up with, and the music that broke out of the parental styles.
- Today, too, we observe the culture wars, with moral traditionalists on one side and young people comfortable with gay marriage, abortion, multi-racial friendships, feminism, atheism, environmentalism, and legalized drugs.
- these culture wars will probably intensify.
- What we see in the politics of countries, like Trump, Brexit, and across Europe, is a reflection of these culture wars
- This is even a greater problem in traditional societies and countries where the forces of traditionalism had a stronger hold and the change is more abrupt and disruptive.

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- If we think of this online video, as just as another distribution platform for the same stuff, we are not thinking far enough. High enough.
- The new distribution form affects style and content.
- The changed medium creates a changed message. Just like film was not just theater that was recorded and distributed differently.
- It may have started that way, but quickly became something else, and dramatically so.

Emerging TV

- Immersive
- Vertically interactive
- Peer-to-peer horizontally interactive
- Diverse in technology
- Diverse in platforms
- Personalized
- Participatory
- Experiential
- Globalized

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- **Content: From Story to Experience**
- visual media will evolve from narrative to experience.
- Not all of it, of course. But the leading edge of content and its high attention, high creativity, big-budget content creation will be oriented to create environments in which users actively participate, and whose level of stimulation and involvement they can regulate to suit their desired mood.

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- In the past, “entertainment” content followed basically the model of novels and plays. A structured plot, comprised of scenes and chapters. Taking the viewer in a tightly edited plot, with pre-programmed emotions of excitement, horror, anger, sadness, arousal, laughter. In this scenario, the viewer was the spectator

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- Media consumption will move in that direction, in which the user will be more than a viewer, and become a participant in an experience, beyond the current choice that is limited to switch on/switch off. This is part of a more general trend to an “experience economy”, where companies go beyond offering a good or a service but create and specific experiences, created on an industrial scale. Whereas earlier stages of economic development dealt with physical needs -- satisfying needs for food, clothing,

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- transportation, and alleviating physical labor—the focus of economic development is increasingly to serve psychological needs such as dealing with boredom and search for companionship. Whereas the goal of the industrial economy was to save time, the goal of the post-industrial economy is to fill that time meaningfully

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Experiential Media emerge for several reasons

- the technology makes it possible
- the economics makes it affordable
- viewers crave new types of experiences
- creators seek originality
- marketers seek new approaches to engage consumers
- media companies seek audiences

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A new discipline emerging:

“Content Engineering”

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„Content Engineering“

- Personalization tools
- Participation tools
- Authoring tools
- Branching story lines
- Content processing
- Semantic analysis

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Personalization

- Almost certainly this starts with personalized Advertising serving
- But then also Content serving
- And going beyond that, Content personalization

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- Now obviously not all of video will be like that.
- Linear will be around, but shrinking
- Immersive content will be the frontier of technical and cultural creativity
- The destruction will be soft. Users will use interactive sometimes, but they do not have to.
- There will be a lot of individualization that is automatic.
- Or, a basic storyline and model may be possible

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- Q: who will be the creators and producers of such video content?

- The conventional wisdom is that everybody can enter, that there will be a lot of user-generated content, and content from a lot of countries.
- I am much more skeptical.
- Sure, there will be a lot of specialized, long-tail, content.
- But for the mass market, the trend would be in the opposite direction.

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- To produce such immersive, interactive content is expensive
- It requires creativity, many programmers, lots of alpha and beta testing, and many new versions

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- Both favor content providers with
 - big budgets
 - can diversify risk
 - can distribute over other platforms
 - Brand
 - Delivery of large audiences
 - Ability to coordinate specialized inputs

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- Such expensive content exhibits strong economies of scale on the content production side,
- and network externalities on the demand side.
- And distance-insensitivity on the distribution end.

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- These factors are also available elsewhere, but probably nowhere quite in such combination or magnitude. (On the other hand, the US lacks the supportive mechanism of public TV that exists in Europe and Japan.)

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- But the main audience will still be attached to big-budget, technically sophisticated productions that combine Hollywood glitz with Silicon Valley tech.

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- That means that major Hollywood distributors will be even stronger, because they now have a more direct link to global audiences.

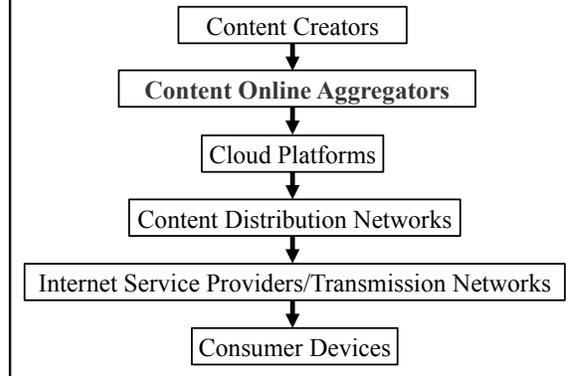
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Content Producers (US)

- Traditional Hollywood majors
- Traditional major cable channels
 - Discovery, HBO, Showtime
- New content aggregators
 - Netflix, Google YouTube, Amazon, Facebook
- Sports leagues

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The Chain of Online TV



Online Video Content Providers in US

- Fox, Comcast (NBC), Disney & Time Warner: **Hulu**
- Viacom: CBS All Access, Showtime Anytime
- HBO Go and HBO Now
- Google: YouTube
- Netflix
- Amazon Prime Video
- AT&T DirecTV Now
- Dish: Sling TV
- Apple
- Sony: Playstation Vue
- Facebook: Facebook Live
- Microsoft
- Snapchat
- Twitter Periscope (UGC)
- Walmart vudu
- Vimeo
- BBC
- Vivendi Dailymotion
- CinemaNow
- Disney: ESPN, Hulu
- Sports Leagues: NBA, NFL, MLB, WWE
- Verizon: AOL, Yahoo, FiOS
- Veoh (P2P)
- Vevo (music videos)

Content Providers

- The dominant player, by far, is Netflix.
- Industry Revenue was \$10.8 Billion in 2013. PwC predicts \$14 Billion by 2017, higher than film theater box office.

Content Providers

- Netflix uses Amazon’s cloud service for storage and transmission. It also has begun building its own server farm to offload its costs and dependence on Amazon.
- Vimeo uses Amazon’s cloud processing service (EC2 and S3) for processing and transcoding videos into a playable format and then storing them.

Content Aggregator Market Shares by Time Viewed

Netflix	59%
Google Sites	26%
Facebook	3%
Amazon Sites	3%
NDN	2%
AOL	2%
Yahoo Sites	1%
VEVO	1%
Microsoft Sites	1%
Vimeo	1%
hulu	1%
ZEFR	0.2%

Facebook Live

- People can share user generated live streams and videos.
- Facebook pays some publishers such as Vox Media to create live video broadcasts for Facebook Live.
- Live broadcasts can last up to 4 hours. After the stream, recordings of the video can be made available.
- Videos are free for users / consumers.
- Facebook shares 55% of ad revenues with live broadcasters. Model similar to YouTube model.

Snapchat

- Snapchats stories provides a unique way for users to share user generated videos.
- Snapchat enables through their “Discover” feature publishing partners to share videos with followers.
- Publishers working with Snapchat include CNN, ESPN, National Geographic, Vice, Cosmo, Comedy Central, the Food Network, MTV, People, Yahoo News, and the Daily Mail. Some will promote news stories while others will publicize TV shows and entertainment content.
- Videos are free for users / consumers.
- Publishers can keep 70% of the revenue if they sell the campaign, if snapchats sells it, revenue is split 50-50.

Hulu TV

- Subscribers get access to about 50 channels of live TV for \$40 a month. They also can access Hulu’s streaming library, which allows users to stream video with ads.
- Also includes 50 hours of cloud DVR storage.
- Does not include many big name channels including HBO and the package of Viacom channels, such as Comedy Central, Nickelodeon, and MTV.

Sling TV

- Users can sign up for \$20 a month, which gives users access to 30 channels, including ESPN. \$25 a month provides 45 channels. Most Viacom channels are included, but CBS is not included.
- Cloud DVR is included.
- Numerous Add ons, allowing for dozens of extra channels, are available, including international channels.

YouTube TV

- Google has been testing this service in several major cities like New York City, Philadelphia, and San Francisco.
- Users pay \$35 a month for 40 channels.
- Missing channels from Turner, such as CNN, HBO, TBS and TNT as well as Viacom channels such as MTV and Comedy Central.

DirectTV Now

- Allows users to sign up for different sized packages, varying from \$35 a month for 60 channels up to \$70 a month for 120 channels.
- HBO can be added for \$5 more a month.
- CBS is not available.

Sony Playstation Vue

- Available to users on numerous devices, even though the name includes Playstation.
- Pricing starts at \$40 a month, which provides 45 channels, going up to \$75 a month, which gives 95 channels.
- HBO can be added for \$15 a month.
- Missing Viacom channels such as Comedy Central and MTV.

CBS All Access

- Gives access to live streaming CBS, original streaming shows, and CBS's back catalog streaming.
- Cost is \$6 a month with limited commercials or \$10 a month for commercial free.

- User generated content, allowing users to turn on their app and share live streaming video.
- Users can save their broadcasts and leave them available for later viewing.

- Online Video Activities Of Apple, Hbo, Microsoft, Viacom, Walmart Vudu, Veoh, Cinemanow, Espn, Mlb, Nfl, Wwf, Nba NDN, AOL, Yahoo, Vivo, Zefr, And In The Us For Bbc, Dailymotion,

Apple Video Activities

- Make movies and TV shows available for rental and purchase. Apple offers over 85,000 movies and 300,000 TV show episodes.
- Work on multiple different devices (laptops, Apple TV, iPhone, iPad) and are cross synced. Meaning a user can start a movie on their laptop, pause it, and resume on their Apple TV later.
- Had originally planned on developing their own original content (Carpool Karaoke) but delayed it to late 2017.

HBO Video

- Have two offerings, HBO Go and HBO Now
- HBO Go is linked to MSO subscriptions, giving access to MSO subscribers to stream HBO content, including new and old TV shows, and movies. It does not have a live component, but rather is pull oriented.
- HBO Now allows users to sign up for \$15 a month for access to the HBO Go library.

HBO Video

- As of February 2017, HBO Now has 2 million domestic subscribers. This is a 150% growth from the end of 2015, the first year HBO Now was available, when there were 800,000 domestic subscribers.

Microsoft Video

- Microsoft offers Movie and TV show rentals and purchases for streaming on computers and on their Xbox platform.
- Microsoft also offers a service called "Microsoft Stream" which allows organizations to share videos internally for work purposes. Some suggested means of this is HR training videos, product advertisements etc. This service is private and can only be viewed by members of the team.

Viacom

- Offers a service called CBS All Access
- Gives access to live streaming CBS, original streaming shows, and CBS's back catalog streaming.
- Cost is \$6 a month with limited commercials or \$10 a month for commercial free.
- As of 2017, has around 1.5 million subscribers.

Viacom

- Also offers two Showtime products.
- Showtime Anytime is an MSO application, allowing MSO subscribers to Showtime to access the catalog of Movie and TV shows offered by Showtime anywhere and on any device for free.
- Showtime is also available as a stand alone streaming service. For \$10.99 a month subscribers are able to access the same portfolio of shows and movies that Showtime Anytime members have access to, as well as live streams of the Showtime East and West Coast TV channels.

Viacom

- Showtime has 1.5 million digital subscribers, as of February 2017.

Walmart Vudu

- Vudu offers two services.
- Vudu allows for users to buy or rent Movies and TV Shows for instant streaming, similar to Microsoft and Apple.
- In 2016 began offering a service called Vudu Movies on Us which provides people with access to free movies with ad support. The catalog is less focusing on new movies, and more on well known classics and blockbusters.

Veoh

- Online streaming site similar to Google's Youtube.
- Allows content owners to upload their own content for free access by viewers.
- Advertising revenue is generated by viewers watching and the funds are then distributed to the uploaders.
- [who are they]

CinemaNow

- Allows users to buy and rent Movies and TV shows to play on a wide range of devices including computers, smart TVs, Xbox, and other devices.
- [who are they?]

ESPN (Disney & Hearst)

- ESPN offers WatchESPN, a service for MSO subscribers to stream ESPN channels on any device after authenticating their MSO subscription.
- Viewers are able to watch live ESPN channels.

MLB

- MLB offers MLB.tv, allowing fans to stream all out of market games for \$24.99 a month. Fans can also select to follow a single team and watch all of their out of market games for only \$14 a month.
- This only allows viewing of out of market games. If a person living in New York wants to be able to stream New York Yankee games, they cannot because it is "in market".
- This prevents cord cutters to take advantage of this application. It really only appeals to transplant fans (i.e. someone who grew up in Detroit wanting to follow the Tigers in New York)
- In 2015, MLB.tv had 3.5 million subscribers

NBA

- NBA League Pass allows users to watch every NBA game anywhere, on any device.
- League Pass runs \$200 for the season.
- Users are able to access around 40 games a week.
- In 2016, NBA League Pass had 26.7 million subscribers

NFL

- Thursday Night NFL games are now being streamed by Amazon, who paid \$50 million in 2017 for the simulcast rights (the games are aired on Television as well).
- Amazon Prime Video members will get the access to Thursday Night NFL games free of charge.
- NFL also offers NFL Sunday Ticket, giving access to NFL games for \$49.99 a month with a 4 month contract.

WWE Network

- Offers live streaming video, curated by the WWE.
- Also offers entire WWE catalog available on demand, as well as original content.
- WWE also includes their monthly pay per view streams included in the network. The full library has over 100,000 hours of content
- Costs \$9.99 a month.
- WWE has 1.5 million subscribers as of February 2017.

AOL

- Produces News video for news stories
- Also has original video programming such as “Why Didn’t I Learn This In School?” and “Anthony Eats America”.
- Many of AOL’s shows are old (produced 3-4 years ago) and made available for free (ad supported) streaming

Yahoo

- Yahoo launched “Yahoo View” which took over Hulu’s free tier of content, and shows the latest 5 episodes from major network shows from ABC, NBC, and Fox.
- This was originally what Hulu offered, but as it became more popular with its paid service, the free material became less trafficked, so they worked out a deal with Yahoo where Yahoo serves the video and splits advertising revenue with Hulu.
- Also produces video for its news.

Vevo

- The go-to site for Music Videos (taking over the place of MTV from the 80s-90s).
- Owned by a combination of the major music labels, Google, and Abu Dhabi Media.
- The music labels produce the videos and then upload them onto Vevo.
- Also make “exclusive” content available, such as intimate, live performances, rare tracks and other content, produced by the record label.

BBC in the US

- BBC makes its BBC America shows available for streaming (such as Doctor Who, The Graham Norton Show, and Top Gear)
- However access is restricted to MSO subscribers. Users can not access episodes if they do not have a log in and authentication account.

Daily Motion in US

- Dailymotion makes all of its video available to US users.
- Channels are curated by uploaders, with content being recommended to a user. However, like YouTube, user generated content is easily available.

Actual Performance (Strong, Weak, % Or Other Indicators Etc) In Video Distribution Of Netflix, Amazon, Hulu, Apple, And Other Majors. How Does One Categoriye Or Characteriye Apple?

Video Distribution By Netflix

- Netflix had built out its own CDN system, called Open Connect.
- Netflix claims that as of 2016, Open Connect handles 100% of their video traffic, approximately 125 million hours of video a day.
- Netflix has combined their CDN system with Amazon AWS to handle their systems. Everything that happens BEFORE hitting play on a film/tv show takes place on Amazon's AWS system

Video Distribution By Netflix

- This means the User Interface and interaction is taking place in the Amazon AWS cloud, which Netflix transferred over to in 2015, after closing down its own data centers.
- After play is hit, Netflix's Open Connect CDN delivers the requested video to the users residential ISP, at the closest geographical location, putting the data as close to the user as possible.

Video Distribution By Netflix

- In some cases, some ISPs have included Netflix's Open Connect Appliances (the physical device used as part of their CDN) directly into their network, basically putting a Netflix Server directly into the network, so that Netflix traffic does not even have to come "further" upstream on the internet, it is already loaded on the network, it does not need to get brought in from an interchange.

Video Distribution by Amazon

- Amazon uses its own Amazon CloudFront CDN for delivering its video traffic.
- CloudFront has continued to get stronger, including now offering their services to outside sources. Non-Amaon users can also employ CloudFront for content delivery.

Video Distribution by Hulu

- Hulu uses Akamai's CDN network. This was one of the CDN's used by Netflix before they decided to build out their own network.
- Akamai is one of the top two CDNs in the United States, so it makes sense that many video streaming sites would use it.
- Hulu does not generate the kind of traffic where it would make sense for them to build their own CDN, where as Netflix comprises almost 36% of all Internet Traffic, Hulu is 2.7%.

Video Distribution by Apple

- Apple has its own CDN which it uses for delivering large downloads. It has been used for video downloads, where a user purchases a video on iTunes and downloads it to their device. However their internal CDN is usually used for their software downloads.
- For streaming video, i.e. rentals and purchases of movies that are not downloaded and put on their device for offline play, are handled by either Akamai or Level 3

Overall video distribution Market

- Akamai and Level 3 still play a large part of the CDN market for most online video services. Major players, like HBO Go use Level 3 for their content delivery. The largest players have slowly begun building out their own CDNs, (Amazon, Google, Netflix), given the massive amounts of traffic they move but the vast amount of video services still rely on CDNs (and even Amazon, Google and Netflix use CDNs in certain situations, such as countries where they haven't built out yet)

Conclusion on Market Structure of Content Aggregators

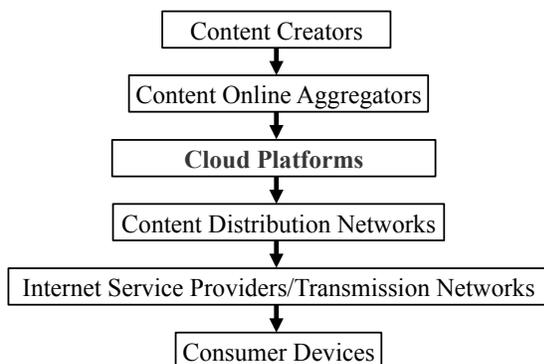
- The current diversity of players is likely to shake out to a smaller number.
- Smaller but not small.

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- Not a natural oligopoly but normally fairly un-concentrated and competitive.
- However, concentration in the upstream or downstream markets might lead to concentration in content aggregation sites, too.

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The Chain of Online TV



Cloud Infrastructure Platform Providers

- Amazon (60%)
 - Netflix
- Salesforce (20%)
- Microsoft (15%)
- IBM (5%)
- Google (new)
- Verizon Terremark
- HP
- Apple
- CSC
- CenturyLink
- Rackspace

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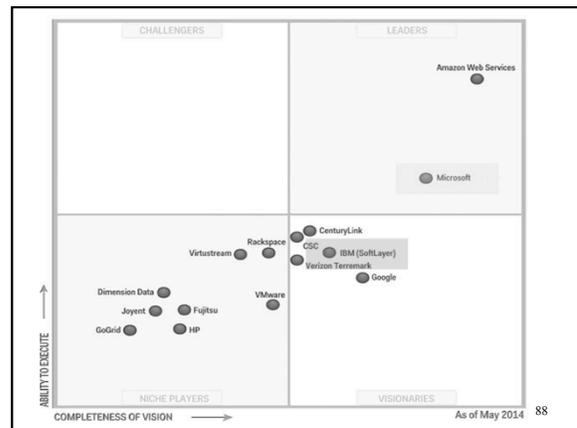
- Large Customers include, for major cloud platforms:
 - Amazon
 - Netflix
 - Google
 - YouTube
 - Microsoft
 - NBC News

- Self-Providers:
 - Some companies maintain large physical infrastructures for their own internal use and do not sell access to other parties.
 - Example Apple; large server farms for use in iTunes music and video distribution and iCloud storage.
 - Disney also maintains a private cloud infrastructure for its video game division Disney Interactive.

Server Farm



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Provider of Physical infrastructure

- In 2014 an \$11 Billion a year industry; Forrester estimates about \$40 Billion in 2020.
- There are 5 major players in this field. Amazon, Google, Microsoft, Salesforce, and IBM.
- Amazon dominates the market.
 - Market share is ~60% by revenue
- Salesforce ~20%, Microsoft ~15% IBM ~5%.
- Google recently entered into this space

- Apple does not make its services available to outside companies.
- Apple has Data centers in Oregon, North Carolina, California, and Nevada. They are also attempting to build a new Data Center in Mesa Arizona and are in the process of building a new 372,893 square foot data center in Reno Nevada. Internationally, Apple has Data Centers in Ireland and Denmark.
- The Data centers are used for iTunes app distribution, iCloud storage, and cloud photo storage.

- Google has 15 data centers worldwide.
- Google's US data centers are located in North and South Carolina, Iowa, Georgia, Alabama, Oklahoma, Tennessee, and Oregon.
- They also have data centers in Chile, Taiwan, Singapore, Ireland, the Netherlands, Finland, and Belgium.

- Google has offered since 2008 access to their cloud for a product called Google App Engine, which allowed application developers to plug into the Google cloud and not have to worry about infrastructure. It allows for App storage, distributed computing, traffic routing etc.
- Google charges based on which data center is being used and what resources are needed. Charges range from 5.5 cents per hour per instance to 44 cents per hour per instance.

- Google also offers Google Cloud Platform, which offers virtual machines for use of processing. Similar to the App engine, they charge per hour per instance, with a number of variants that determine pricing (including support, memory, storage, processors, and location).
- Google's data farm is also used to power everything Google, including Gmail, Google's search engine, and their cloud storage for things like Drive and photos

- Google is highly competitive to Amazon in terms of Web services and renting out access to its data servers. Amazon, Google, and Microsoft make up the "Big 3" in terms of providers of data center services.

- Microsoft has 34 data centers located around the world. Microsoft has many server farms in Europe to allow users in the EU to keep data within the EU. Microsoft also became one of the first US companies to open a data center in main land China in 2014.

- Microsoft uses the data centers for their own data use, such as Onedrive, cloud storage, and it's Xbox video game services (for online gaming).
- Data farm services has been a major area in which Microsoft has transformed itself, offering their public cloud product "Azure" which grew profit 93% in 2016.
- Microsoft's commercial cloud brought in \$14 billion in 2016.
- Similar to Google, Microsoft's Azure offers App Service allowing application designers to pay to use the Microsoft Cloud, as well as offering Virtual machines to handle web services.

- Along with Google and Amazon, Microsoft makes up the “Big 3” data service providers.
- Amazon’s market share is about 40%, while Microsoft and Google make up another 20%. The remainder of the market is IBM with about 5%, the next 10 largest firms with a combined market share of 18%, and the remainder at 17%.

- Verizon has been slowly exiting the self owned data server business.
- Verizon sold 29 of their data farms for \$3.6 billion to Equinix in December 2016.
- Verizon now sells data center access on behalf of Equinix, with Equinix owning the data centers and Verizon managing it on behalf of their partners.

- HP’s data centers are for internal storage and information.
- They also offer “FaaS”, facilities as a service. Companies hire HP to build a data center on their behalf, the data is owned by the company, the facility is owned by HP. This gives the client company the ability to customize the data center to their needs, but the management and ownership is maintained by HP.

- Akamai does not really compete with Amazon.
- Their data centers are used for Web performance, Content Delivery, and Security.
- Akamai has 15 data centers in the United States and 42 data centers around the world.
- Akamai provides traffic management and DNS services as part of their web performance offerings.
- The major use of Akamai’s data centers would be their CDN services, allowing content owners to host and transmit their content easily and quickly around the world.
- Their security services are used for websites to prevent DDoS attacks.

- Owned by Verizon since 2011, having been acquired for \$1.4 billion.
- Own 3 data centers worldwide, 2 in the United States, 1 in the Netherlands.
- Provide enterprise cloud services, mainly for government contractors. Terremark was the company responsible for hosting Healthcare.gov during its rollout problems.

- Equinix is the world’s largest owner of data centers. As of 2017, they own 175 centers in 43 markets.
- Equinix is a colocation facility, which basically just rents out space to companies looking for data center space.
- 2016 revenue was \$3.6 billion.
- Equinix’s clients are almost all exclusively corporations.

Market Structure of Cloud Platform Industry

- Huge capital requirements, very low marginal costs= high economies of scale.
- One way around this is through “virtual” cloud platforms.
- Even these have still high ec of scale.
- So this industry is highly concentrated

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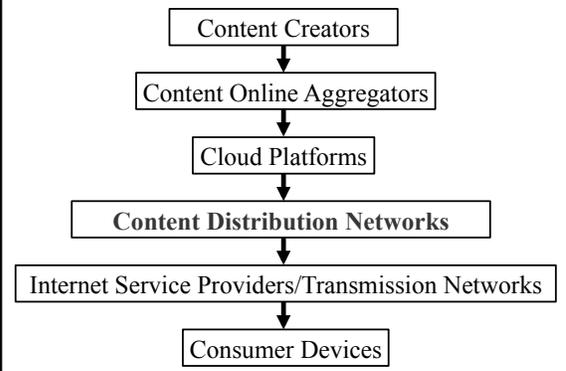
Virtual Cloud Providers

- Virtual Cloud Provider
 - Cloud rents resources from a Level 1 company, adds value, and resells to as B2B or B2C

Virtual Cloud Provider

- Contested field for data, many competitors.
 - Dropbox, Box, Sugarsync, WeTransfer, SpiderOak, MediaFire, Mega, Wuala, 4shared.com, and Hightail
 - Dropbox and Box two of the larger competitors in this field, based on users.
- In 2012 Box claimed that 92% of Fortune 500 companies used Box in some form.
- For video, virtual cloud platform providers are:

The Chain of Online TV



CDNs

- CDNs transport the content that is stored and processed by the cloud platforms and deliver them to the public internet, that is, to the Internet service providers, the ISPs

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- Some content aggregators operate their own CDN operation.
 - Netflix,
 - Amazon CloudFront,
 - Apple,
 - Google,
 - Microsoft Azure,

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- Other content aggregators use CDNs that operate for various customers.
 - Akamai (Operates for Hulu,
 - Apple, used to Netflix),
 - Amazon CloudFront,
 - Cloudflare,
 - Level 3 (Apple, HBO),
 - Microsoft Azure (NBC)

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2013 CDN Market Share

Amazon	25.8%
Akamai	25%
Edgecast	8.5%
Max CDN	7.4%
Cloudflare	6.7%

- CDN industry is highly concentrated.

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Video Distribution By Netflix

- Netflix had built out its own CDN system, called Open Connect.
- Netflix claims that as of 2016, Open Connect handles 100% of their video traffic, approximately 125 million hours of video a day.
- Netflix has combined their CDN system with Amazon AWS to handle their systems. Everything that happens BEFORE hitting play on a film/tv show takes place on Amazon's AWS system

Video Distribution By Netflix

- This means the User Interface and interaction is taking place in the Amazon AWS cloud, which Netflix transferred over to in 2015, after closing down its own data centers.
- After play is hit, Netflix's Open Connect CDN delivers the requested video to the users residential ISP, at the closest geographical location, putting the data as close to the user as possible.

Video Distribution By Netflix

- In some cases, some ISPs have included Netflix's Open Connect Appliances (the physical device used as part of their CDN) directly into their network, basically putting a Netflix Server directly into the network, so that Netflix traffic does not even have to come "further" upstream on the internet, it is already loaded on the network, it does not need to get brought in from an interchange.

Video Distribution by Amazon

- Amazon uses its own Amazon CloudFront CDN for delivering its video traffic.
- CloudFront has continued to get stronger, including now offering their services to outside sources. Non-A Amazon users can also employ CloudFront for content delivery.

Video Distribution by Hulu

- Hulu uses Akamai's CDN network. This was one of the CDNs used by Netflix before they decided to build out their own network.
- Akamai is one of the top two CDNs in the United States, so it makes sense that many video streaming sites would use it.
- Hulu does not generate the kind of traffic where it would make sense for them to build their own CDN, where as Netflix comprises almost 36% of all Internet Traffic, Hulu is 2.7%.

Video Distribution by Apple

- Apple has its own CDN which it uses for delivering large downloads. It has been used for video downloads, where a user purchases a video on iTunes and downloads it to their device. However their internal CDN is usually used for their software downloads.
- For streaming video, i.e. rentals and purchases of movies that are not downloaded and put on their device for offline play, are handled by either Akamai or Level 3

Overall video distribution Market

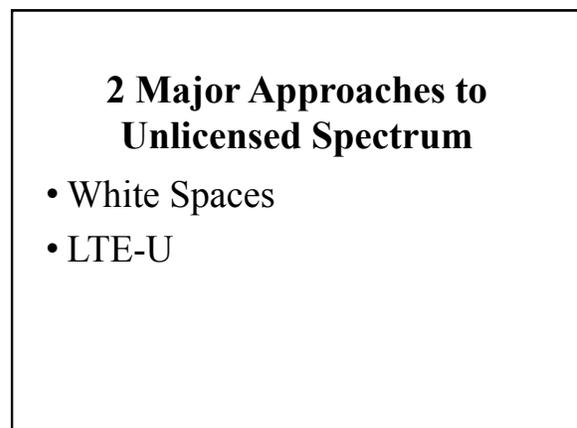
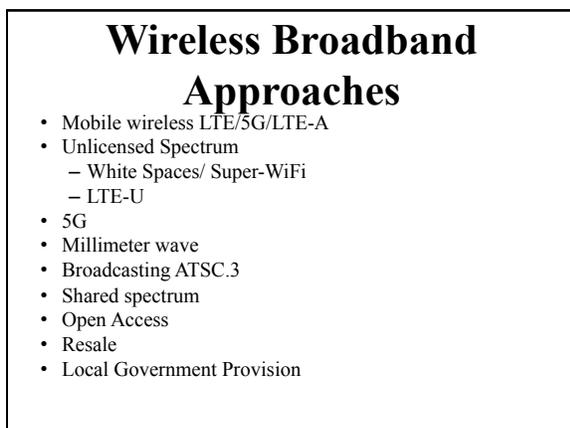
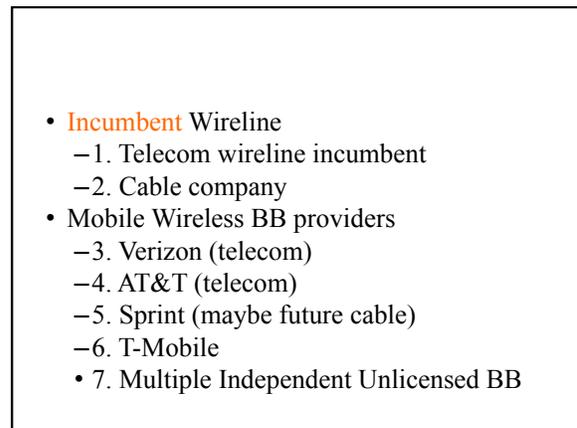
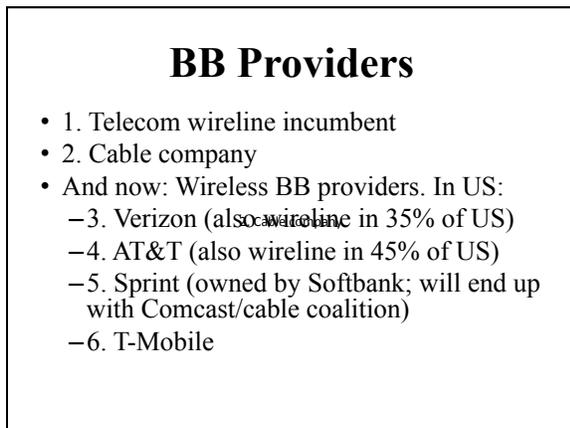
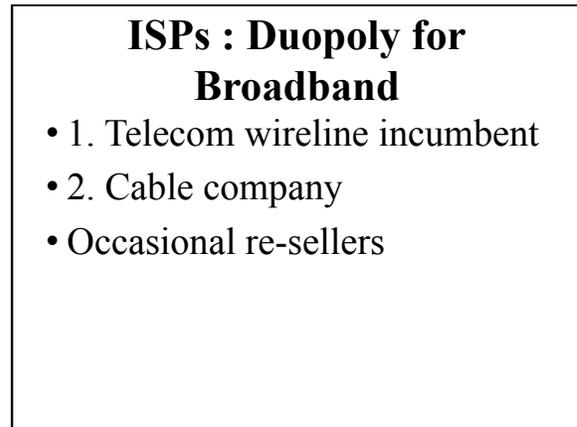
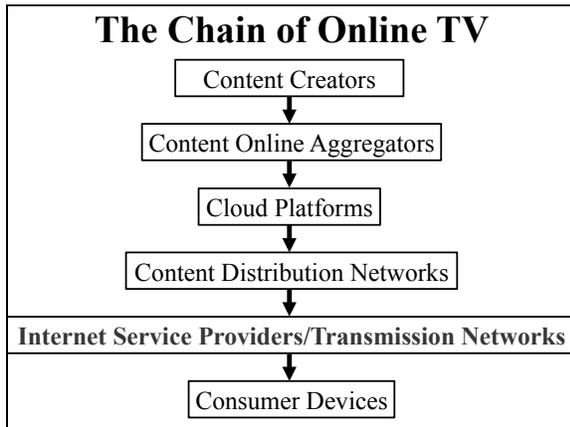
- Akamai and Level 3 still play a large part of the CDN market for most online video services. Major players, like HBO Go use Level 3 for their content delivery. The largest players have slowly begun building out their own CDNs, (Amazon, Google, Netflix), given the massive amounts of traffic they move but the vast amount of video services still rely on CDNs (and even Amazon, Google and Netflix use CDNs in certain situations, such as countries where they haven't built out yet)

Microsoft

- Microsoft offers their Azure platform for video services.
- The service was launched in 2013 and continues to grow in terms of its dominance.
- Users can upload a single video to the Azure platform. Microsoft will then re encode it for use on different bitrate quality streams, allowing for the video to reach users on lower-quality services. Microsoft then stores the different versions of the video and distributes it as needed.

Microsoft

- NBC used Microsoft's Azure platform in 2014 with streaming the Winter Olympics, as well as 2016 with the Summer Olympics in Rio.
- For the Olympics, Microsoft's Azure is the platform on which everything runs. It encodes the video and transmits it, as well as storing it for later viewing.
- Akamai handles quality monitoring and pinpointing service issues, helping to route traffic as needed. [for MS? For NBC?]
- Adobe handles authentication, making sure users who are watching are supposed to be, as well as advertising insertion into the video. [Same Q]



Super WiFi

- In 700 MHz range, white spaces, C-Block, and opened by incentive Auction
- Pushed in particular by Microsoft

LTE-U

LTE-U

- FCC Gives the Green Light to LTE-U: Move Over Wi-Fi
- This is indeed a big, if somewhat ironic, win for the mobile operators.

- In his first major move since assuming the chairmanship of the FCC, Ajit Pai announced the agency's first authorization for
- the use of LTE-U (LTE-Unlicensed) devices operating in the 5-GHz unlicensed band. Both Verizon and T-Mobile plan to
- launch LTE-U capabilities this spring,

LTE-U Coalitions

- Telecom operators and vendors: Evolve
- Cable, Google, and other tech: WiFi Alliance

Telecom Alliances

- When the idea of LTE-U first surfaced, it developed into something of a shoving match between the mobile operators and the Wi-Fi industry. On the mobile **operator side**, the first group to coalesce was Evolve, fronted by AT&T, Verizon, T-Mobile, Qualcomm, Nokia, Ericsson
- A second group called the MulteFire Alliance with many of the same members has also stepped into the fray and is developing a specification for an LTE based technology for small cells operating solely in unlicensed spectrum.
- Also: The 3GPP, the group that develops standards for the cellular industry, has also weighed in on the use of unlicensed spectrum.

- Fronting the battle for the Wi-Fi side has been the Wi-Fi Alliance, with support from Google and a number of cable operators, many of whom have built extensive public Wi-Fi networks for their customers

Google Last Mile Wireless

- Perhaps these and other realities have led Google to look at faster and less expensive ways to deliver ultrabroadband
- to the home. Maybe even a Google Fiber fixed wireless approach? A recent filing at the FCC
- (<https://apps.fcc.gov/els/GetAtt.html?id=172888&x>) suggests that Google is experimenting with just that. It's
- impossible to tell from the filing what Google's ultimate plans are, but they are definitely snooping around wireless
- delivery of broadband.

Millimeter Waves

- Industry interest in such technology is snowballing. AT&T and Verizon have
- announced trials for millimeter wave
- fixed wireless systems, and major
- players like Qualcomm, Nokia,
- Ericsson, Huawei, and Google are
- working on versions. Samsung is
- working on mobile technologies using
- 64 antennas to send and receive
- signals on ultra-high frequencies. And
- researchers at New York University
- have also tested advanced versions for
- mobile networks.

LiFi: Free Space Laser, 1 Gbps



A supplementary BB service: Broadcasting new Standard

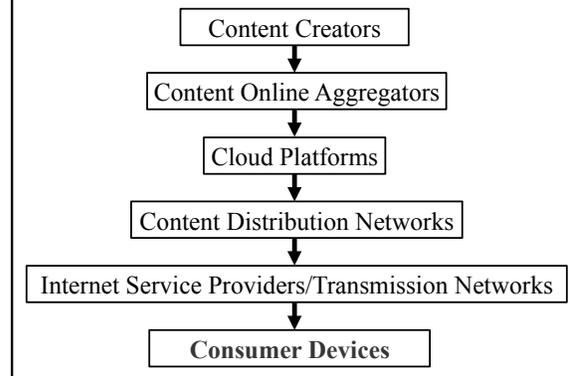
- ATSC.3 enables IP transmission

Conclusion on ISP market structure

- Currently highly concentrated duopoly
- Potentially somewhat more open and oligopoly

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The Chain of Online TV



The Chain of Online TV

- Content Creators
- Content Online Aggregators
- Cloud Platforms
- Content Distribution Networks
- Internet Service Providers/
Transmission Networks
- **Consumer Devices**

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Efforts of Integration

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Integrator Strategy #1: Vertical Integration

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A. ISP-Centric Vertical Ownership Integration

- Content Creators
- Content Online Providers
- Cloud Platforms
- Content Distribution Networks
- **Internet Service Providers/
Transmission Networks**
- Consumer Devices

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Vertically Integrated Online Video Cloud Providers

- 1. With network distribution
 - AT&T (DirecTV): DirecTV Now
 - Verizon: FiOS package
 - Comcast (with Fox and Time Warner): Hulu

Verizon - internet TV service

- Announced plans to provide a package of dozens of channels in 2016.
- So far unknown, whether it will include on-demand content or premium channel options, or what platforms it will be usable on.
- Price is believed to be between \$20 and \$35 per month.

Charter - Spectrum TV App

- Charter offers a streaming service for their broadband customers.
- Customers can pay \$13 a month to stream local broadcast channels and either HBO or Showtime. For an additional \$7, subscribers will receive an additional 13 cable channels, including ESPN and AMC.

B. Consumer Device–Centric Integration

- **Content Creators**
- **Content Online Providers**
- Cloud Platforms
- Content Distribution Networks
- Internet Service Providers/Transmission Networks
- **Consumer Devices**

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Examples

- Sony PSP
- Apple
- Samsung
- Microsoft xBox

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Pro/Con

- **Pro:**
 - Positive user experience
- **Con:**
 - Rarely successful
 - Narrow silo, limited user choices

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C. Content Provider-centric Integration

- Content Creators
- **Content Online Providers**
- Cloud Platforms
- Content Distribution Networks
- Internet Service Providers/Transmission Networks
- Consumer Devices

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Examples

- Netflix, without the cloud platform for which it uses Amazon

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Advantages of Vertical Integration

- End-to-end control of product and quality
 - Ability to control content
- Brand
- Squeeze and foreclosure of competitors

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Disadvantages of Vertical Integration

- Less access to other verticals
- Lock-in to own technologies and elements
- Policy problems
 - Entry barriers to non-integrated rivals
 - Example: Net Zero
- Policy antagonism and regulatory restrictions
 - Example: net neutrality rules

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Net-Zero

- Creates a major vertical squeeze opportunity
- Rival content providers must, in effect, pay incremental price, while own content is “free”, or rather bundled into flat BB price.

Options to remedy those problems?

- Structural: Require vertical de-mergers
 - Kick out cable MSOs from offering content, packaging channels, and producing programs. But only in franchise territory. Realistic?
- Structural: require horizontal de-mergers
 - Separate wireline and wireless for good. But only in franchise territory. Efficient?
- Behavioral: Outlaw net-zero and other discounts
 - Requires continued regulation. Can't offer ESPN at cheaper rate?

Integration Strategy #2: Cloud Integration

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Cloud-Centric Virtual Integration

- Content Creators
- Content Online Providers
- **Cloud Platforms**
- Content Distribution Networks
- Internet Service Providers/Transmission Networks

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Main Candidates

- Amazon
- Google
- Apple
- Microsoft
- Facebook

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- in the future, I will argue, clouds will become the main media players.
- Why?
- There are at least 8 good reasons.

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Why Clouds Will Dominate Online Video

- 1. Bridging the diversity of options and standards
- 2. Convenience to endusers
- 3. Compliance with diverse national laws
- 4. Financial settlements and distribution to various participants in the chain
- 5. Marketing, branding, quality control
- 6. Privacy and security
- 7. Data mining, personalization, and ad-serving

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- These advantages will make the cloud integrators more powerful than the vertical ownership integrators.
- In consequence, they will become the central institutions of the future media system.
- And they will do so nationally and globally.

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- Each newer generation of media is more concentrated than the earlier ones. This is true almost everywhere.
- Traditional media have a concentration index, worldwide, of about 1100, which is unconcentrated
- 20th century media have a concentration index of about 2000, which is already highly concentrated.
- And internet media have an index of over 3000, which is very highly concentrated.

These are the industries that were believed to be wide open and competitive, which would open things up for the rest. But they exhibit strong concentration trends. The underlying economic factors, are easy to describe: High fixed cost and low marginal cost on the supply side, and high network effects on the demand side. This creates very high advantages to scale.

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Conclusion on Market Structure of Clouds

- Many content providers
 - Many technology providers
 - Numerous providers of specialized modules
- BUT:
- A handful of cloud integrators globally

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Presentation Outline

- 1. 3rd Generation TV--Overview
- 2. Media Industry Structure of 3rd Generation TV
 - Content Creators
 - Content Online Aggregators
 - Cloud Platforms
 - Content Distribution Networks
 - Internet Service Providers/Transmission Networks
 - Consumer Devices
- 3. Policy and Societal Issues of 3rd Generation TV

- 3rd Generation of TV
 - Dominated by a small set of cloud service providers
 - Content increasingly experiential
 - Acceleration of cultural changes
 - Acceleration of political changes
 - Difficult for societies to control

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Societal Implications

- **Demand-driven upgrade of Infrastructure**
- **Rapid tech innovation**
- **From passive media consumption to active experience**
- **Opportunities for skills training and education**
- **Opportunities for young people**
- **Opportunities for new players**
- **Greater revenues for content creation**

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Societal Implications

- **Rapidly changing culture**
- **Intensification of communications and marketing**
- **New communities and fragmentation**
- **Arms race in political mobilization**
- **Rising cost of content and its affordability**
- **Weakening of traditional intermediaries and emergence of new curators**
- **Reduction in national culture**

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- *Economic*
- Upgrade of Infrastructure
- Tech innovation
- Skills training and education
- Opportunities for young people
- Opportunities for new players
- Greater revenues for media
- Cost savings to consumers
- Lower cost of production and distribution
- Fewer ads, fewer dumb ads.
- Lowest global denominator?
-

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- Major challenges
- But amazing opportunities.
- I see a form of anarchism emerging.
- Not anarchy in a sense of disorder, but in the sense of an absence of central societal control.
- Things will simply and gradually slide out of the hands of politics and governments.
- And the major challenge, long term, is how to maintain a gradual transformation

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- Regulatory tools of licensing, ownership control, content rules, foreign content, subsidization of users, subsidization of content will be partly ineffective, partly irrelevant, and partly will need to be re-written and re-thought

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- Will concentrated ownership facilitate societal control or hinder it?
- Both scenarios are possible.
- Self-control by an oligopoly is likely.

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- Various stakeholders will soon press for it
- Governments will soon argue for it
- But governments will lack effective and elegant tools.
- So they will do it in clumsy ways.
- If the cloud providers are smart, and they are smart, they will do it themselves.
- Self regulation.

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The 3 Stages of TV Regulation

- Broadcast TV: elite or state control
- Multichannel TV: regulated national pluralism
- Cloud TV: self-regulating global oligopoly

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Is content king?

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Hierarchy of future market power

- Integrated cloud providers
- Network providers
- Content providers

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- And so, not today, not quite tomorrow, but certainly the day after tomorrow, policy makers around the world will be facing this question:

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From Net Neutrality to Cloud Neutrality?

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Thank you! End of Talk

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