

# Grand Alliance

D I G I T A L   H D T V

25<sup>th</sup> Anniversary Retrospective On Our Impact

Glenn Reitmeier  
May 24, 2018

# We Did It! ... We Created A Big Splash

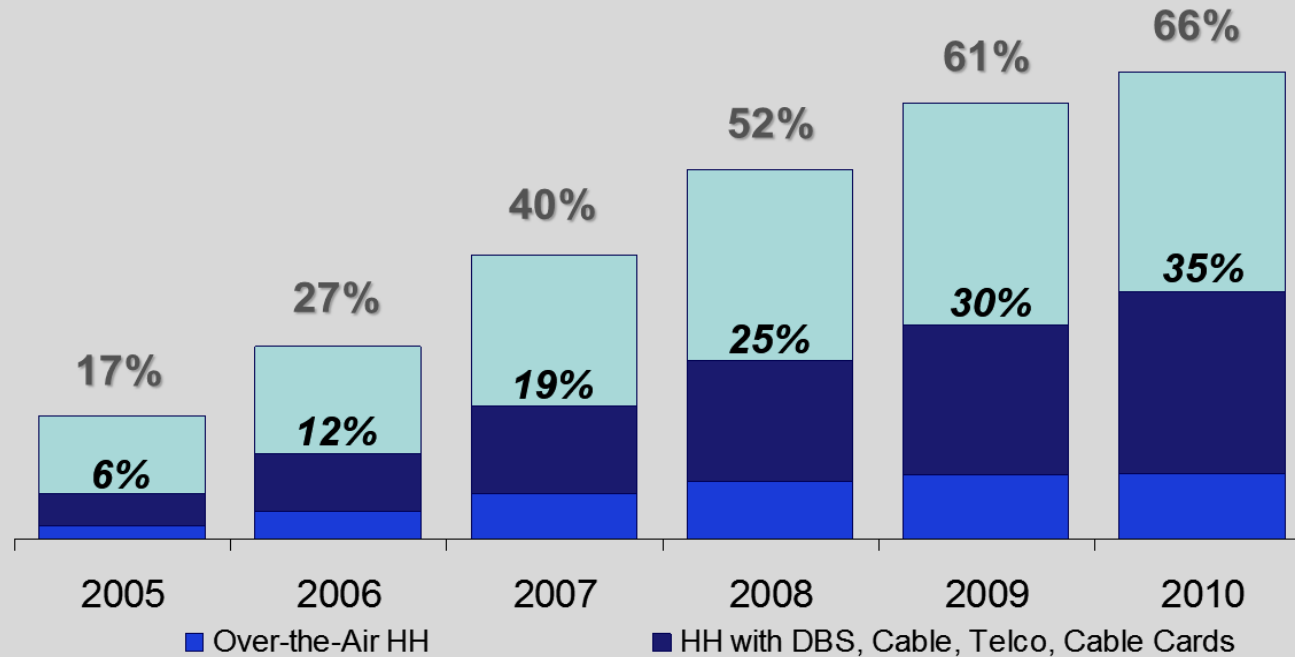


# HDTV Adoption – *all* TVs are HDTVs

## HDTV Adoption



Percent of US Households with HDTV capability\*  
Percent of US Households with HDTV subscriptions\*\*

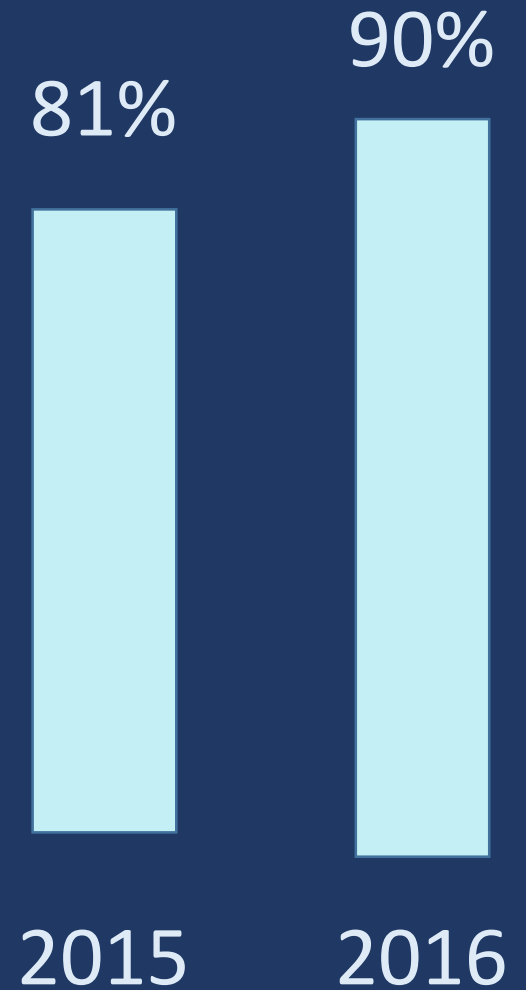


\* HDTV Capable households have an HDTV set capable of delivering HDTV signal but do not necessarily have the cable subscription to receive HD programming

\*\* HDTV Subscribing households have an HDTV-capable set as well that receives HD through DBS, Cable, Telco, Cable Cards or Over-the-Air

Sources: NBCU Internal Estimates, Dec-06

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**DVR**

**DBS**

**Digital  
Cable**

a — t — s — c

Digital HDTV  
**Grand Alliance**

**DB**

We Created A  
*Very*  
Big Splash

# Digital TV



US - 119M TV Households

vast majority digital

53M cable

32M satellite

12M telco IPTV

Europe - 99M pay-TV HHs

Worldwide pay-TV revenue is > \$1.1B

As pay-TV grew, over-the-air broadcast declined to <10% US HHs around 2010

OTA-only HHs now 17M

Antenna sales growing

“cord-cutting” trend

~20% of US broadband internet sub HHs use OTA

DVR

DBS

Blu-ray

Digital  
Cable

DVD

Digital  
Cinema

a — t — s — c

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# Home Video

## Blu-Ray wins DVD battle



- Single format sparks consumer adoption
- Likely last physical-based, video-specific format
  - File-based, flash memory the future of playback
- Internet connectivity comes to Blu-Ray



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1977 - **VHS** VHS/Beta war ... last unit 2016



2002 - in 6 years, >70% adoption in US HHs  
CDs took 14 years, Cell phones 18 years, PCs 25 years

2002 - China made 30M players, ~70% ww total

2003 -  BD/HD-HVD war ... 2007 2.7M players

2013 - “Frozen” sold 3.2M discs in one day

2013 - “Despicable Me 2” >46M discs (US)

2018 - although in step decline, disc sales \$4.7B



DVR

DBS

Blu-ray

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a t s c

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Grand Alliance

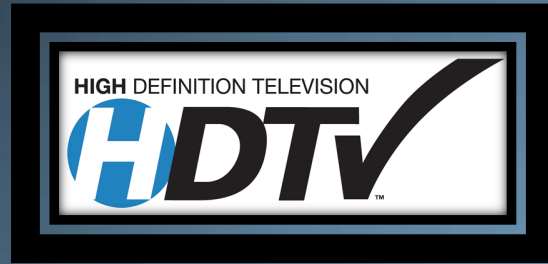
DB

We Created A  
*Very Very*  
Big Splash

**Flat-Panel  
Displays**



# HDTV and Flat-Panel Displays Symbiotic



OLED

8k 7680 x 4320

LCD / LED

High Dynamic Range

Wide Color Gamut

LCD

4k UltraHD 3840 x 2160

DMD/DLP

FullHD 1080p 1920 x 1080

720p 1280 x 720

Plasma

480p

# 1995

# ...2008

# ...2018

## Displays



## HDTV – Plasma & LCD

NBC UNIVERSAL

- Flat displays rule
  - rear-projection dying
- 1080p dominant in >42" & up
  - Panasonic: 17 1080p models, 4 720p
- Bigger, Thinner, Cheaper



HDTVs now in >50% of US HHs

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## In The Future - OLEDs

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- Super high contrast
- Ultra-thin
- Low power

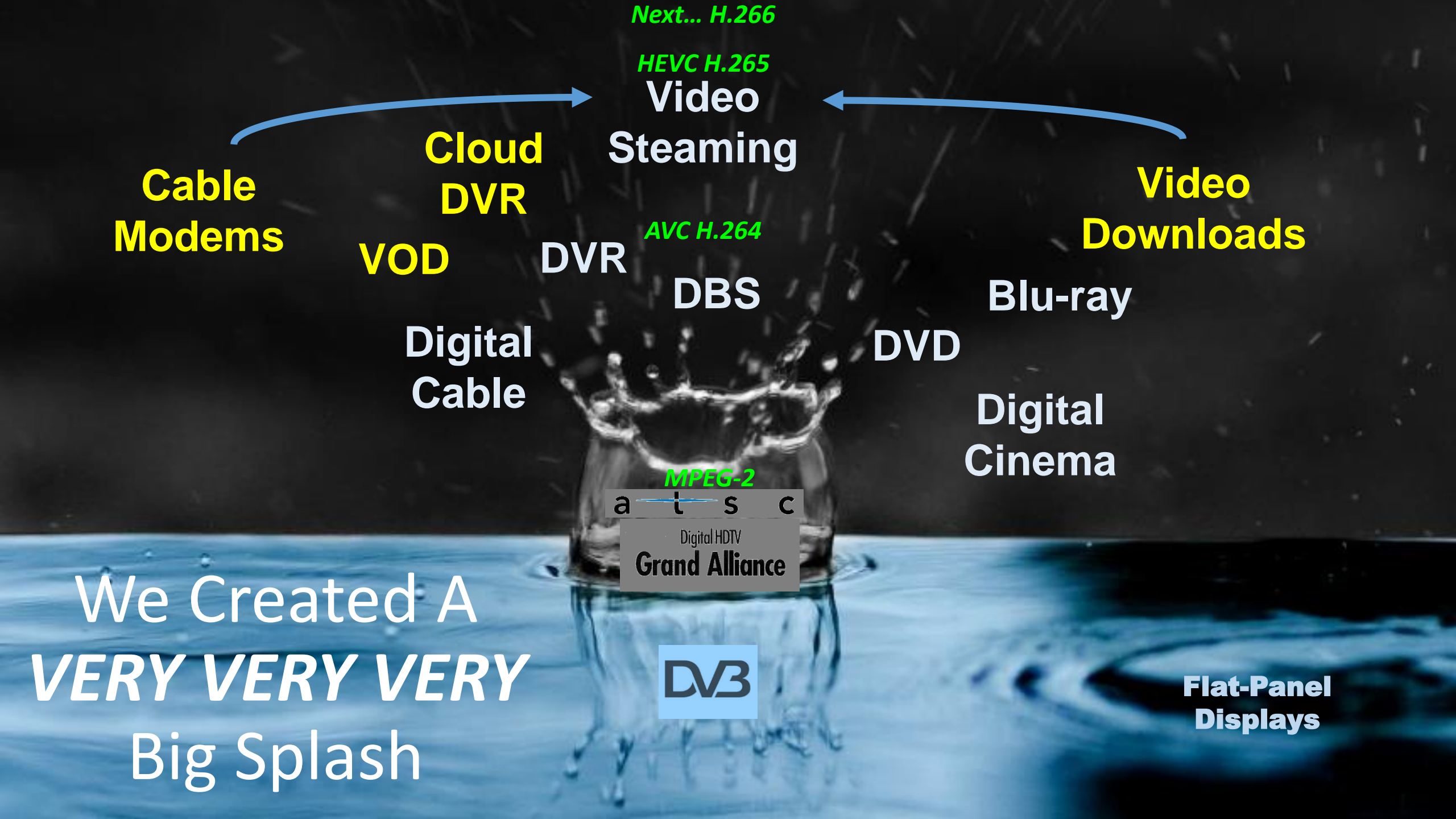


WOW!!

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Next... H.266

HEVC H.265

Video  
Steaming

Cable  
Modems

Cloud  
DVR  
VOD

DVR

AVC H.264

DBS

Video  
Downloads

Blu-ray

DVD

Digital  
Cable

Digital  
Cinema

MPEG-2

a l s c

Digital HDTV

Grand Alliance

DVB

Flat-Panel  
Displays

We Created A  
**VERY VERY VERY**  
Big Splash



# Video Streaming Over The Internet

**4G (2000)**  
kbps

**DOCSIS 3.1 FD**  
10 Gbps / 10 Gbps (2017)

**DOCSIS 3.1 (2013)**  
10 Gbps / 1 Gbps

**DOCSIS 3.0 (2006)**  
Channel Bonding 1 Gbps / 100 Mbps

**DOCSIS 2.0 (2001)**  
40 Mbps / 30 Mbps

**Cable Modems**  
**DOCSIS 1.0**

40 Mbps / 10 Mbps (1997)

**TS/QAM**  
**Digital Cable**

**8/16 VSB**  
**ATSC**  
**Grand Alliance**

**2G (1991)**  
~40 kbps

**HEVC H.265 (2013)**  
HD @ 3 – 4 Mbps

**AVC H.264 (2003)**  
HD @ 6 – 8 Mbps

**HDTV = MPEG-2 @ 19 Mbps**  
**ATSC**  
**Grand Alliance**

# Cable Modems – Broadband Internet

Over 66M Cable BB internet subs (telcos have 32M)

Cable invested > \$230B in networks since 1996

There are 1.7 million miles of Hybrid Fiber Coax in the US

2015 - Comcast ISP subs > TV subs

2017- video streaming revenue > Physical Media sales





# Digital Revolution – Many Astounding Advances and short life cycles with rapid obsolescence

## **Discussion Session**

***Wow -- Things Have Sure Changed!***

**Glenn Reitmeier**  
May 9, 2008

**And the Change Is Accelerating**

**Glenn Reitmeier**  
May 24, 2018



1995

...2008




...2018

# Computing and Memory

Computing Power

## Technology Catalyst - Storage

- Processing – Moore's law
- Communications – increasing fast, but still the bottleneck
- Storage – faster than Moore's law...

	 Flash Memory	 Portable HDD	 Standard HDD
2006	4 GB = 1 DVD = 4 PVs	20 GB = 4 DVDs = 16 PVs	300 GB = 60 DVDs
2008	16 GB = 4 DVDs = 16 PVs	80 GB = 16 DVDs = 64 PVs	1 TB = 180 DVDs = 36 HD
2012 est.	256 GB = 50 DVDs = 200 PVs	1 TB = 180 DVDs = 36 HD	16 TB = 2880 DVDs = 576 HD

10 MB

• Compression will also continue to advance, magnifying effective storage capacity

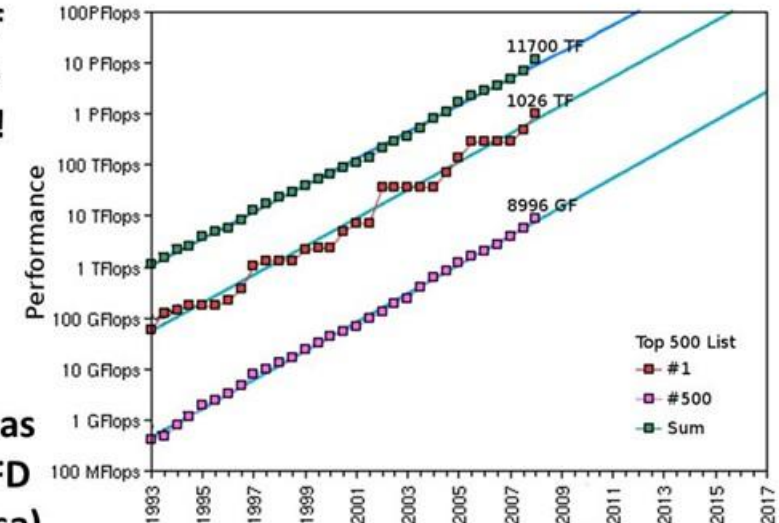
➢ DVD can hold up to 9 GB, using MPEG-2 compression. Advanced video compression (MPEG-4 AVC or WM9) can achieve comparable quality at about half of the MPEG-2 file size

Green Rebrinder

----- 100,000x increase ----->

5 Orders of Magnitude Since 1985!

Advanced Computing has Advanced CFD (and vice versa)



**SUPER SPEED CERTIFIED USB 3.0**

8GB  
16GB  
32GB  
64GB

128GB  
256GB  
512GB  
1TB

real capacity+ 1 year warranty

1995

...2008

... 2018

## Compression Encoding



MPEG-2



MPEG-4 AVC – H.264



- Software on commodity servers
- Encode “in the cloud”



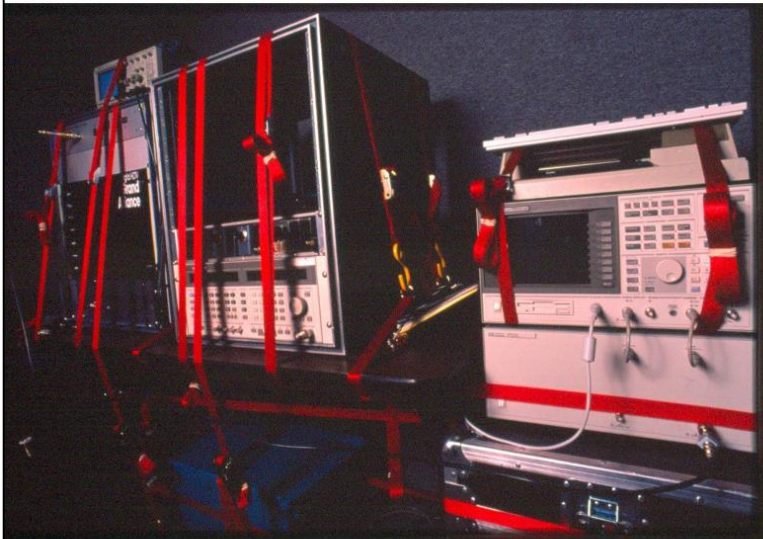


1995

...2008

...2018

## Receivers



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# 1995

Personal Computers



# ...2008



## Technology Catalyst – Laptop PCs

- In 2005, both unit sales and dollar volume of laptops exceeded desktops for the first time!
- Generally have an almost-HD-resolution LCD screen
- Enough processing power to decode HDTV
- Laptops becoming more appliance-like, more portable...
- Higher resolution, lower power consumption, better batteries coming...

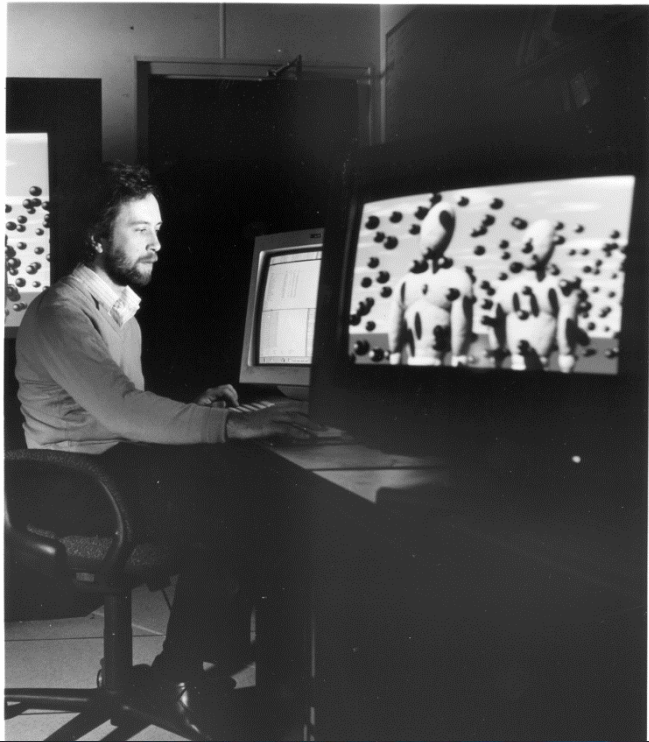


# ...2018

Post-PC Era



1995



...2008  
Graphics



Full HD



...2018



UHD HDR





# 1993



# ...2008 Cameras



# ...2018

Most still cameras have video recording



But cameras themselves are in decline





# The Digital Revolution Has Been a Deluge of Innovation

*Was Digital HDTV inevitable?*

*Was TV just swept along with other digital advances?*

Technology historians will recognize that the HDTV Grand Alliance and the resulting ATSC standard were the *world's first* digital TV and an amazing catalyst

# ATSC 1.0 in Retrospect

*The HDTV Grand Alliance was a Revolution in 1993*

NTSC TV – 1953 analog transmission standard  
CRT tube displays



*2M Pixels – 5x VGA*  
*16M colors – 1,000,000x*

Computer  
DOS ... Windows 3.1



Cell Phone  
Analog 2G

*Wireless*  
*Digital*



*19.4 Mbps*  
*1000x faster*

Dial-up  
Modem  
19.2 kbps



*Compressed*  
*Digital Video*

VCR - analog

