



# Visual Cloud

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# Agenda

- What is Visual Cloud?
- Technology Underpinnings
- What Intel is Doing
- Visual Cloud Grand Research Challenges



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# What is Visual Cloud?



**Visual Understanding**



**Media Delivery**



**Graphics in the Cloud**



# Visual Understanding

- Object Recognition & Tracking
- Indexing / Search
- Smart Cities, Security and Surveillance



*Smart Cities*

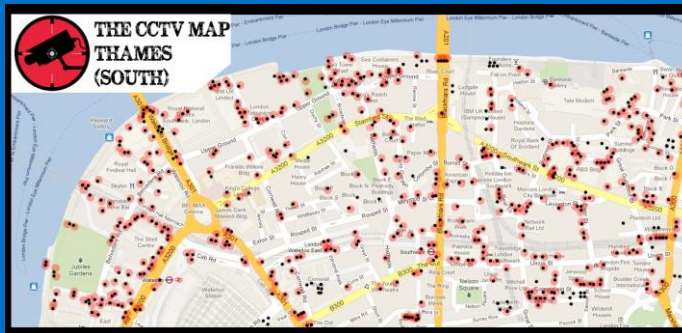


*Facial recognition & tracking*



*Object recognition & tracking*

Technology Breakthroughs  
in Deep Learning Driving  
New Applications



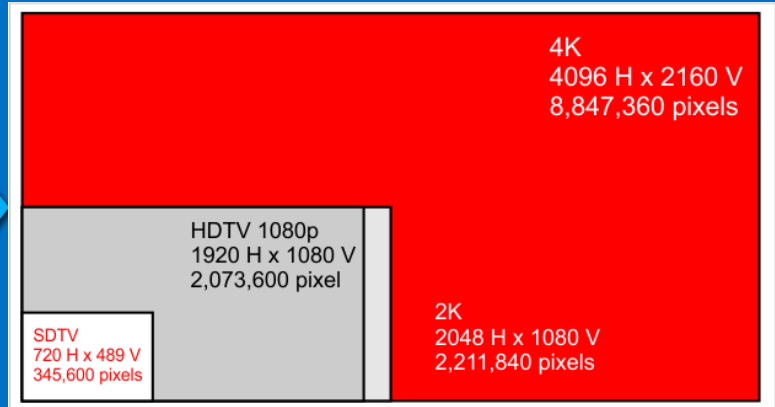
*Intelligent public safety*



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# Media Delivery

- *Ingest / Storage / Edge*
- *Transcode / Trans-size / Trans-rate*
- *Video Collaboration*



Existing Market Going Through  
Technology Transition (Again)

# Graphics in the Cloud

- *Remote Desktop*
- *Remote Workstation*
- *Cloud Gaming*
- *Rendering*



*Cloud Gaming*



**GAIKAI**

**SQUARE  
ENIX**



*Remote Desktop*  
*Remote Workstation*

**CITRIX**

Windows Azure

vmware

amazon  
webservices

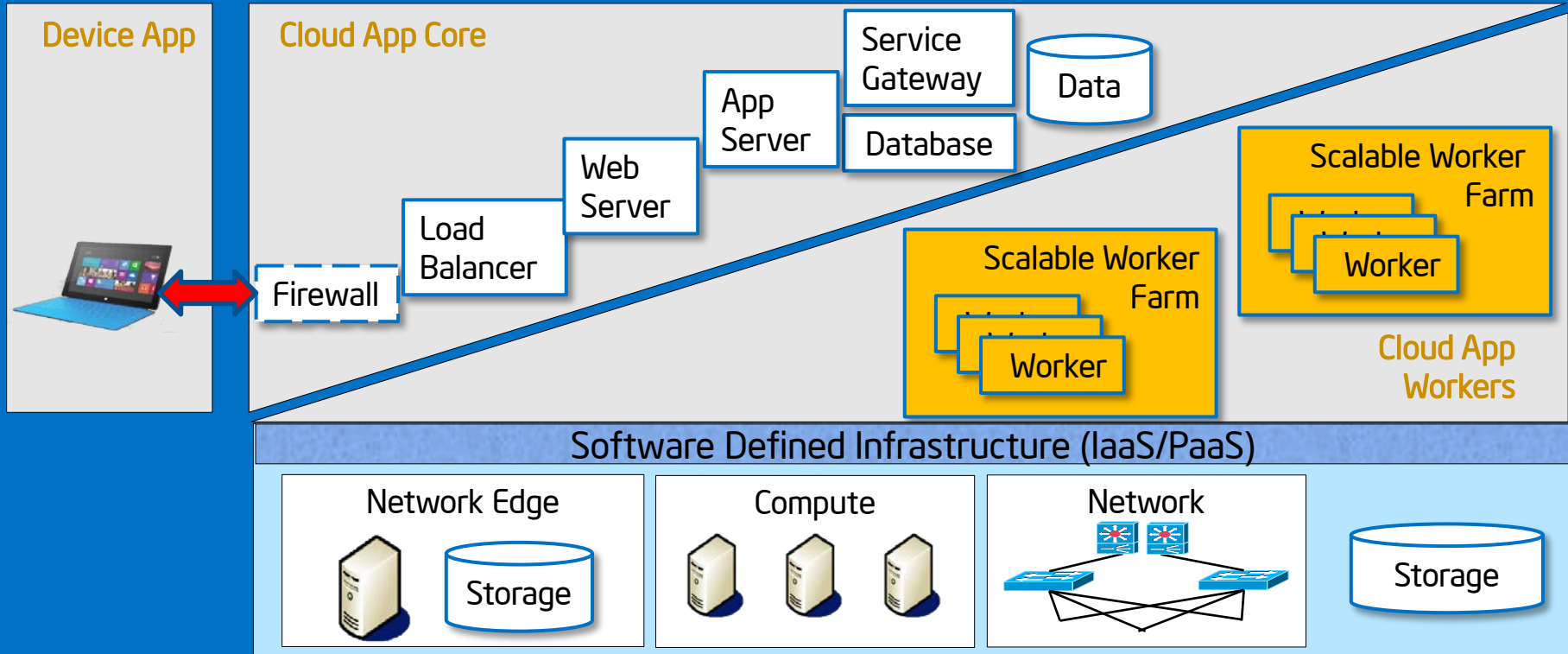
Technology and  
Networks Tipping  
Over to  
"Good Enough"



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# Technology Underpinnings

# Anatomy of a 'Typical' Cloud App





# Visual Cloud Technologies:



## Visual Understanding

Accuracy and Latency

- Training
- Prediction/Recognition
- Image Processing
- Metadata Search/Analytics

Images, Video, Speech, Audio

CPU, GPU, FPGA,  
FF Accelerators



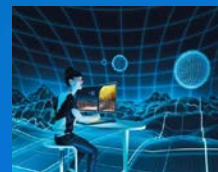
## Media Delivery

Media Quality, Performance  
and Network Bandwidth

- Media Transcoding
- Image Processing

Video, Audio

CPU, GPU, DSP



## Graphics in the Cloud

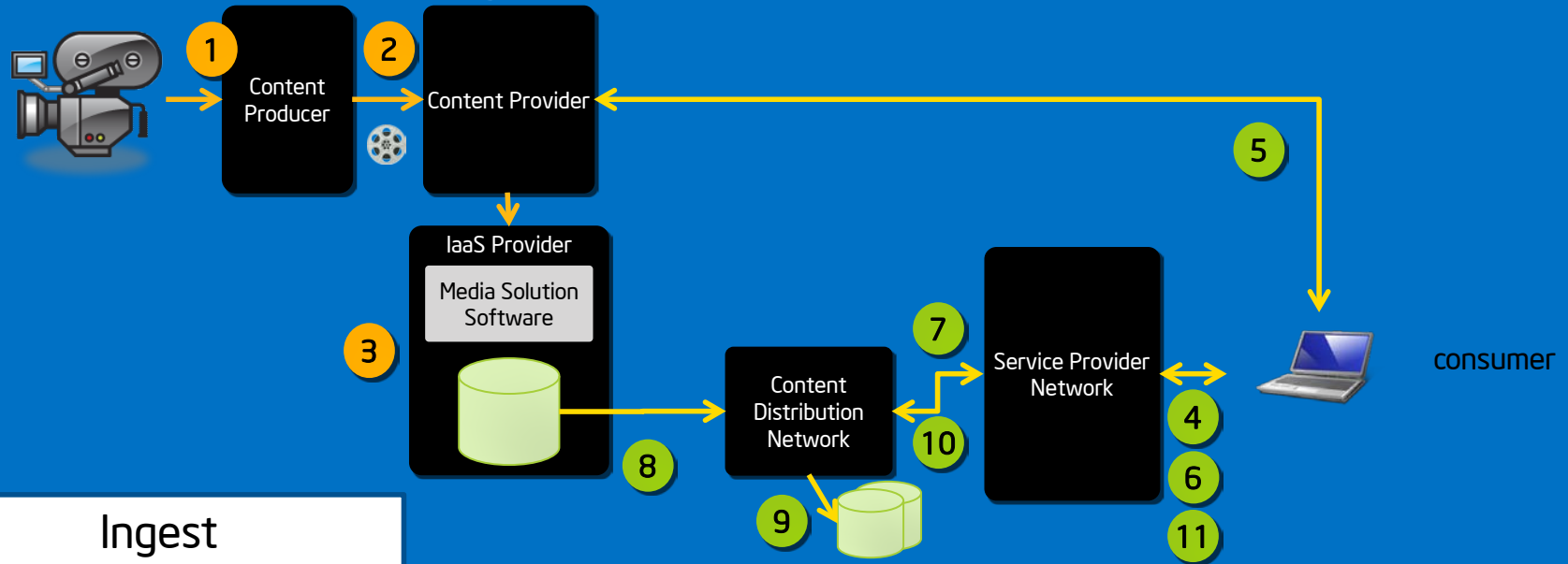
End to End Experience  
(Latency, Quality):

- Rendering
- Media Encoding
- 3D Modeling
- Data Visualization

Games, Big Data,  
Desktops & Apps

CPU, GPU

# Cloud Video Delivery Work Flow



## Ingest

- 1 Capture HQ High Res AV
- 2 Deliver Large Data to Content Provider
- 3 Transcode, Package & Store For Later Delivery

- 4 Consumer connect to their Service Provider
- 5 Consumer authenticates with the Content Provider via App/Web
- 6 Consumer requests video from the Content Provider via SP and CDN
- 7 Service Provider routes request through the CDN

- 8 If not in the CDN Cache, CDN requests the content from the Content Provider
- 9 CDN stores cache object, and/or pulls cache content for delivery
- 10 CDN forwards cached object to the consumer via the SP network
- 11 Service Provider delivers final object to the consumer

# Today's Challenges

- Cloud Heterogeneous Computing **Economics**
- **Programming** Cloud Heterogeneous Computing
  - The Rise of OpenCL
  - Portability Across Environments
- Mobile Device and the Cloud **Division of Labor**
- Access to **Accelerators** in Clouds
  - Abstraction from HW is a "Design Principle"



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# What is Intel Doing



Intel, HP and Citrix  
introduce Iris Pro  
Graphics on Xeon  
June '14



OpenCL®

Intel Supports  
OpenCL on Xeon, GEN  
and Xeon Phi  
October '14



Intel Introduces  
FPGA-Integrated  
Xeon; Deep Learning  
Apps -- June '14

More To Come

# Intel Technology Directions

- Integrating Visual Compute Technology into CPU
  - GPU
  - FPGA
  - Fixed Function Acceleration
- Algorithmic Optimizations
  - Depth Photography
  - Deep Learning
- Defining and Enabling Open APIs
  - Embree (Ray Tracing)
  - OpenCV (Computer Vision)
  - OpenCL (Heterogeneous Compute)



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# Intel Visual Cloud Challenges

- Exposing Specialized Acceleration Through the Cloud & Virtualization Stack
- Application Portability (and Performance) across diverse Cloud implementations
- Enabling non-specialists to build apps
- Hardware Scaling (up and down)

# Visual Cloud Grand Challenges

# Visual Cloud Grand Challenges:

- **Visual Understanding:** Human Quality Computer Vision
  - On 4K Video; In Real Time; At Scale
- **Media Delivery:** Dynamic Video Composition, Rendering and Display
  - On 4k Video; In Real Time; Broadcast Quality
- **Cloud Graphics:** Local Latency and Experience for Fast Twitch Gaming
  - With 4k Display
- **Infrastructure:** Distributed Heterogeneous Computing in the Cloud – At Scale



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# Grand Challenge #1 - The Open Source Visual Compute Platform

*What is the "Hadoop For the Visual Cloud"?*

# Data Center Visual Compute Platform

- **Target Application Use Cases:**

- Interactive Video
- Cloud Gaming
- Visual Design, Art and Science
- Data Visualization
- Dynamic Advertising
- Video Surveillance
- Video Search
- Application Remoting
- RealTime Collaboration
- Augmented Reality
- Computational Photography

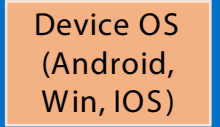
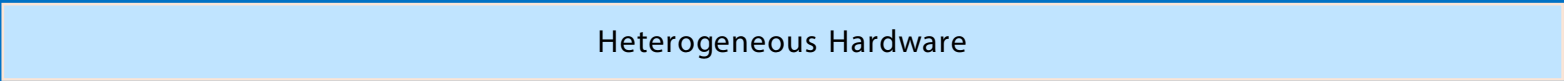
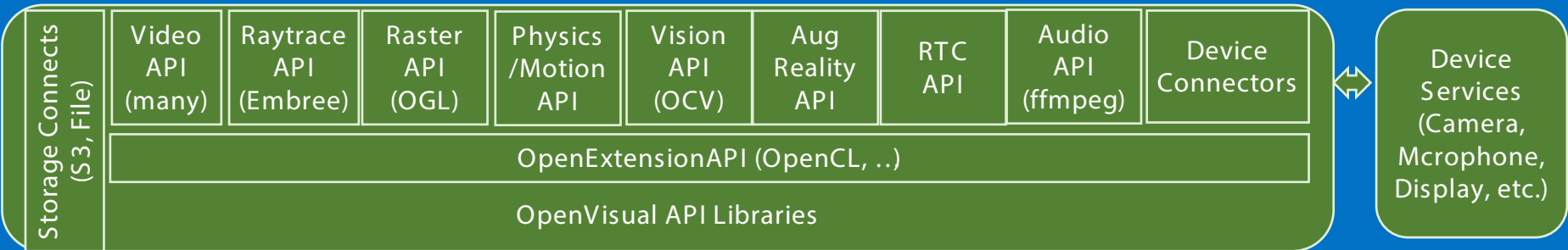
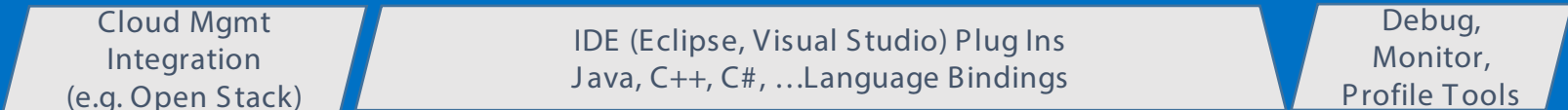
- **Core Platform Capabilities**

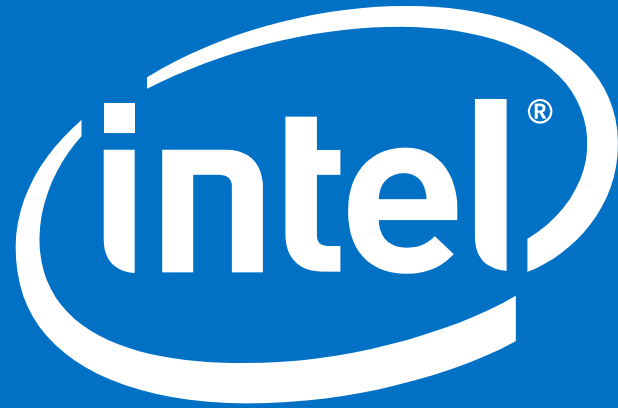
- Media Streaming
- Audio/Video Transcoding
- Audio/Video/Image Search
- Computer Vision
- Rasterization and RayTracing
- Media Conferencing
- Game Physics
- MMORPG Scene Algorithms
- DRM
- Occlusion
- Pixel Remoting
- ???

- **3rd Party Innovation Support**

- Application Creation, Deployment, Operation
- Custom Codecs
- Device Integration
- Cloud Management Integration
- Platform Hosting
- Non-Visual Solution Integration
  - E.g., Hadoop, DB
  - Custom Services Integration

# Data Center Visual Compute Platform Concept

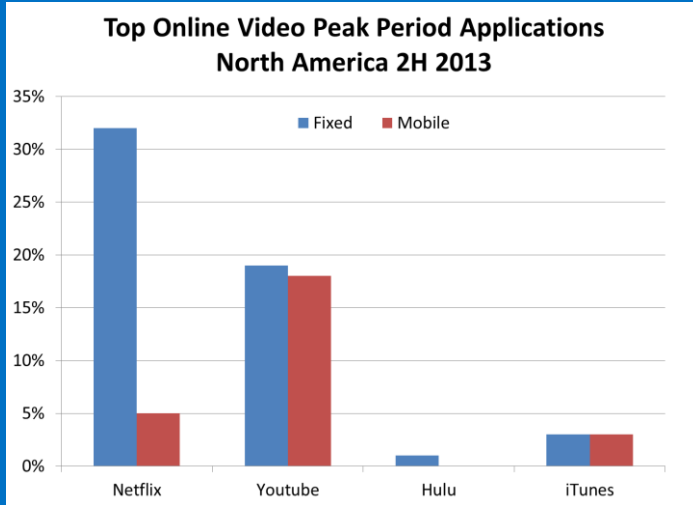




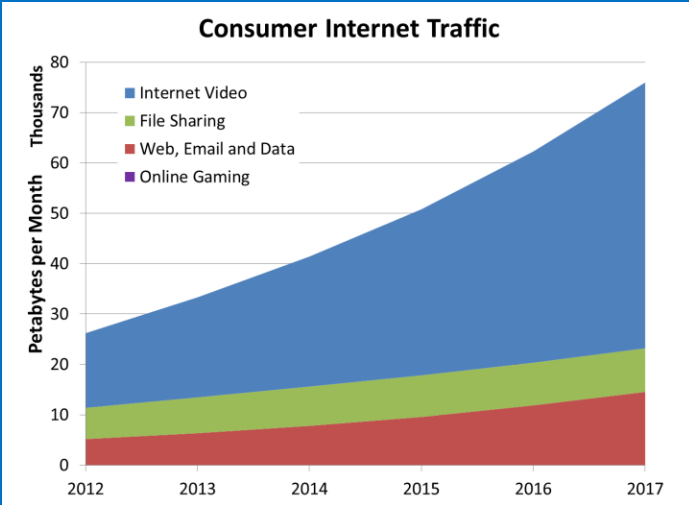
Look Inside.™

BACKUP

# Video Delivery & Transcode Market Opportunity



Source: Sandvine Global Internet Phenomena Report, 2H 2013



Source: Cisco Systems Inc., Visual Network Index (VNI), 2013

**Video Fuels the Growth of Internet Traffic**



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# Data Visualization/Rendering Market

## *DCC*



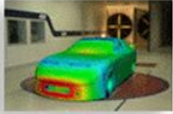
Exponentially more complex rendering  
Ray Tracing, Stereo 3D

## *Bio-Sciences / Healthcare*



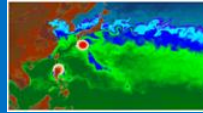
Medical Imaging, Gene simulations

## *CAE / Mfg*



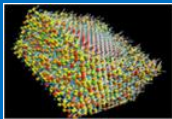
Entire Car Modeling, Car  
Crash Simulation - savings  
from actual car crash tests

## *Weather*



Climate Modeling &  
Simulation, Weather  
Forecasting Visualization

## *Energy / Geosciences*



Reservoir Models, Seismic  
Simulation - Interpretation  
to decide where to drill

*The purpose of scientific visualization is to graphically illustrate scientific data to enable scientists to understand, illustrate, and glean insight from their data.*

*It is used both to debug simulations & to analyze the simulation results*

Use of Visualization Prevalent Across Technical Computing

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