



2023 MILE HIGH VIDEO

# AI/ML in Video

Amit Bagga

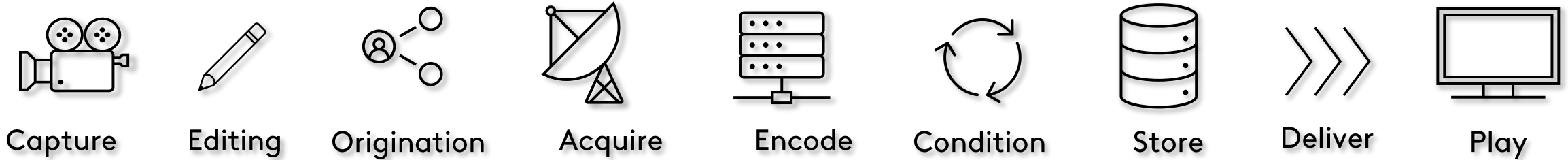
Comcast Video Ecosystem

AI Innovations

AI & Video



# VIPER - Content Video Delivery Platform



End to End Video Distribution @ Comcast scale

Technologies, Services, and Platforms that deliver high quality video to millions of customers across the World

# LIVE & Video On Demand (VOD)

IP & QAM, T6 & OTT

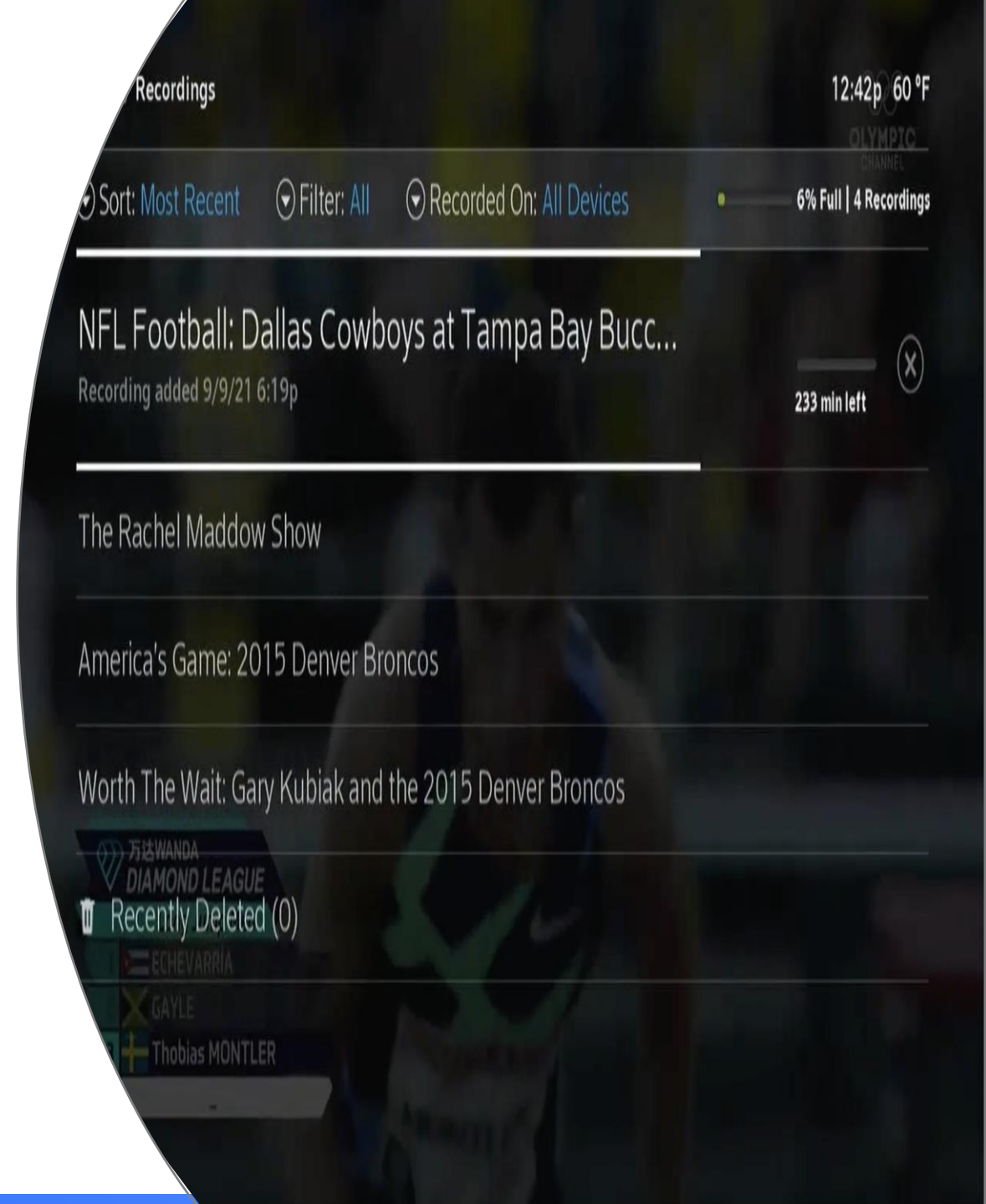
- 18K+ Live Channels
  - majority with 1:1 redundancy
- 30K+ Unique Live Sources
- ESNi based stream stitching & blackouts
- Client side & Server side DAI with Programmer Addressable Support
- Trusted Computing Platforms including multi-DRM & device identity management



# Time Shifted

Cloud DVR, Instant VOD / Restart,  
Pay Per View, Cloud Review Buffer

- 30M+ Daily Recordings
- 5.4M+ Daily Playbacks
- 10B+ Yearly Recordings
- Recording & playback usage trending up
- Common & unique copy configurations depending on territory





## CDN and Player

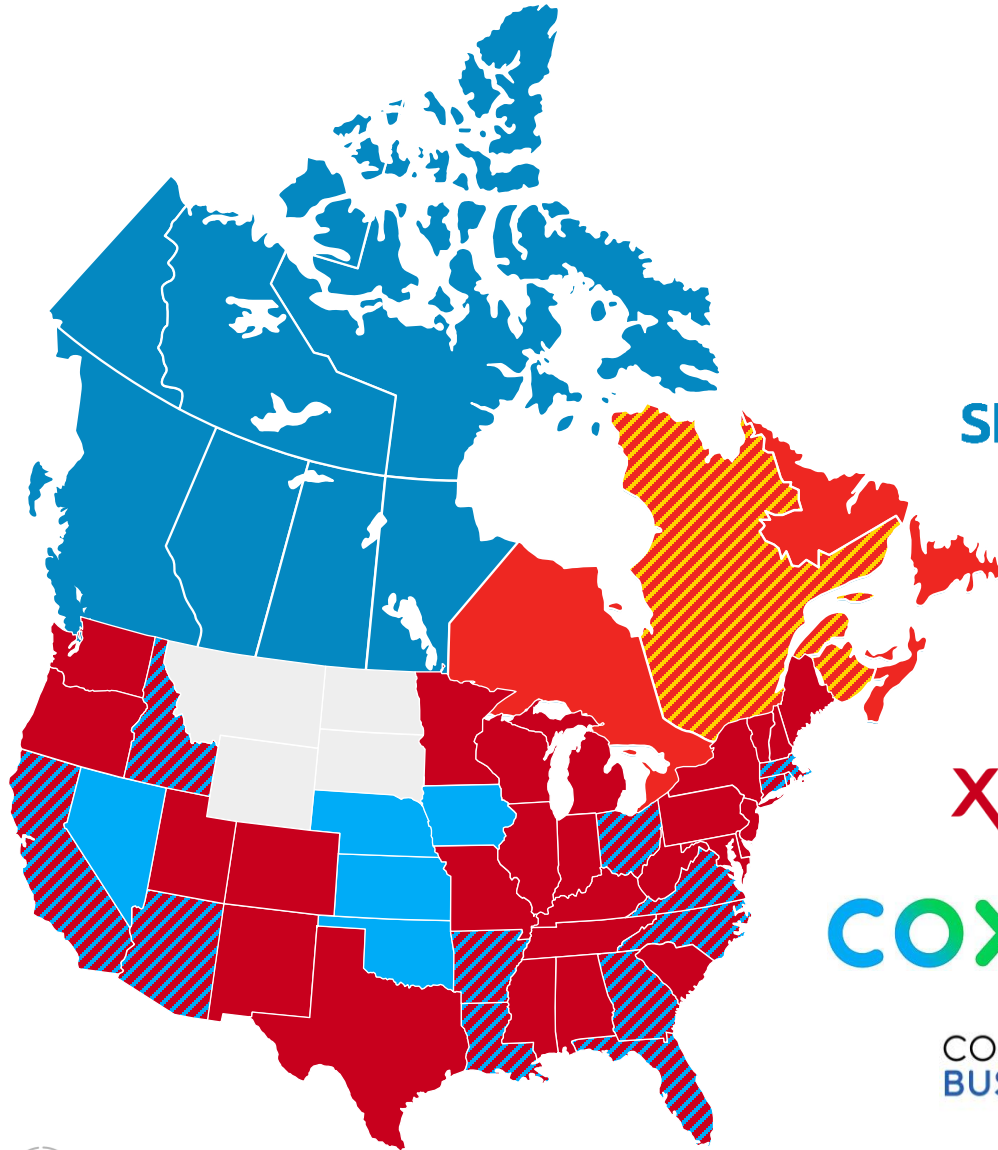
### Title 6 (T6) & OTT

- T6: **9Tbps Daily Peak**, 35Tbps capacity
- OTT: **4Tbps Daily Peak**, 8Tbps capacity
- N-tier built on Apache Traffic Control
- **17M+ Analytics Events** ingested every second
- Multiple player platforms for RDK-V, Web, mobile, Smart TV, etc.



# VIPER – Global Reach

World class technology, people, and processes that deliver high scale, reliable, and high-quality video to millions of customers 24/7.



VIDEOTRON

COMCAST   
TECHNOLOGY SOLUTIONS

xfinity



COX

COMCAST  
BUSINESS

FREEWHEEL  
A COMCAST COMPANY

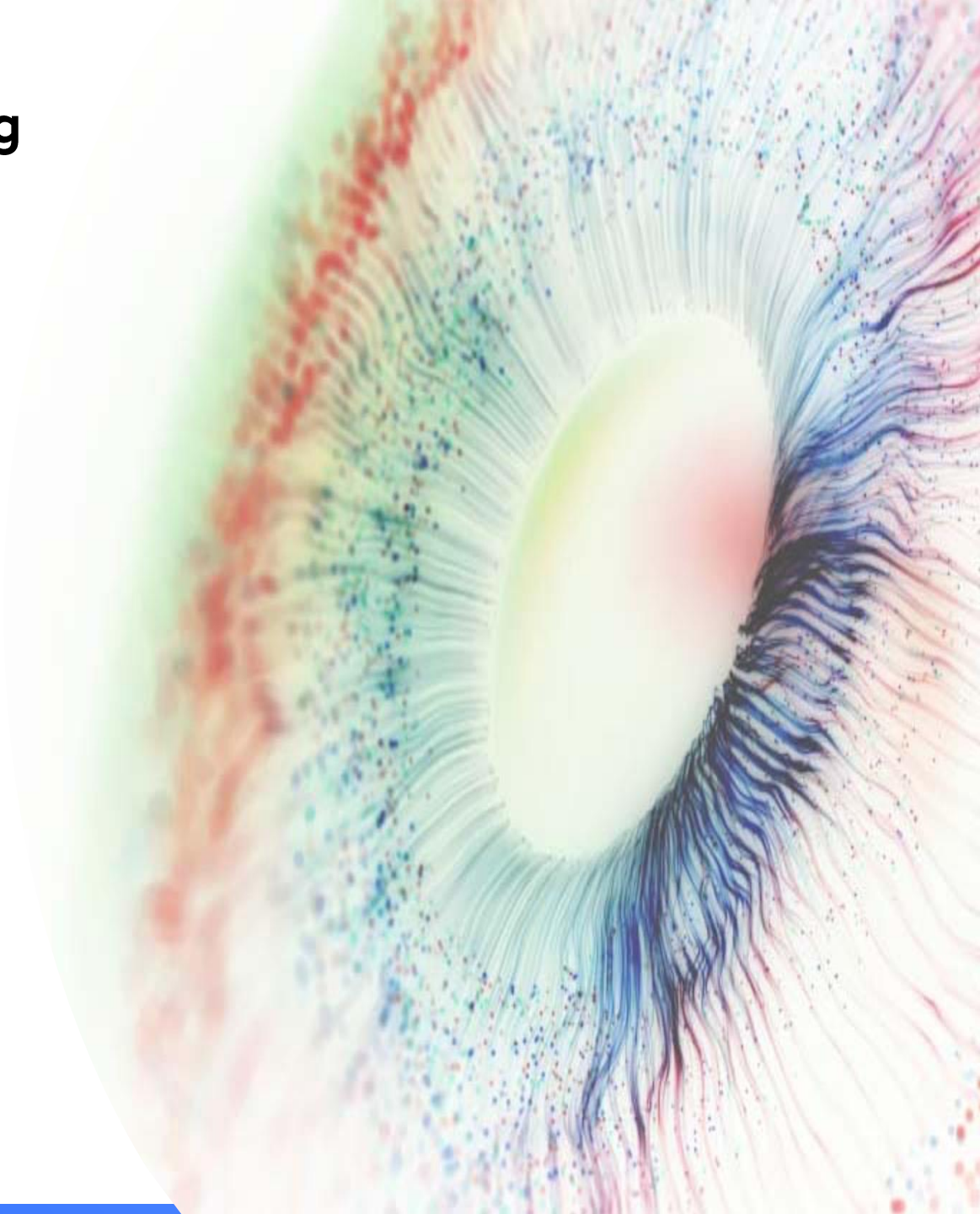


FOXTEL






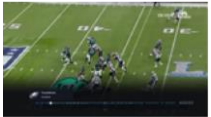


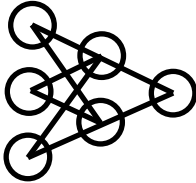


# Artificial Intelligence & Machine Learning at Comcast

- 15+ Years of AI/ML Research & Development
- Extensive Deployment of AI/ML across Applications, Workflows, and Products
- Multidisciplinary Applied Research and Engineering AI/ML Organization
- 3 Technical Emmy Awards
  - Personalization
  - Voice Remote
  - Sport Highlights





# AI/ML Across Different Application Areas

Entertainment		Home	Customer	Network	Security	Enterprise
VOICE & NLP / DISCOVERY	MEDIA ANALYTICS	CONNECTED LIVING	CUSTOMER EXPERIENCE	CONNECT	CYBER SECURITY	SALES & MARKETING
<p><b>Incorporate NLP</b> across ALL Xfinity interactions Provide <b>personalized</b> and <b>contextual</b> results</p> <p><i>Ex: understand speech intent</i></p>  <p><i>Ex: personalized recommendations</i></p> 	<p>Analyze <b>multi-modal metadata</b> to provide enhanced <b>interactivity &amp; improve video workflows</b></p> <p><i>Ex: identifying seamless ad insertion opportunities</i></p>  <p><i>Ex: automatically generating clips</i></p> 	<p>Analyze in-home data to recognize <b>anomalies</b> and <b>anticipate needs</b></p> <p><i>Ex: enhanced detection analytics for XH camera</i></p> 	<p><b>Automate customer assistance</b> and assist agents &amp; technicians</p> <p><i>Ex: increase accuracy of XA</i></p> 	<p><b>Optimize network</b> delivery efficiency and <b>detect impairment</b> in the network</p> <p><i>Ex: optimize modulation for each channel</i></p> 	<p>Find <b>secrets</b> in source code and <b>detect anomalies</b> in logs</p> <p><i>Ex: scan GitHub for hardcoded security vulnerabilities</i></p> 	<p><b>Decision engine</b> that recommends <b>next best action</b> to an agent</p> <p><i>Ex: recommend the best package for a customer</i></p> 

# AI/ML Across the Video Ecosystem

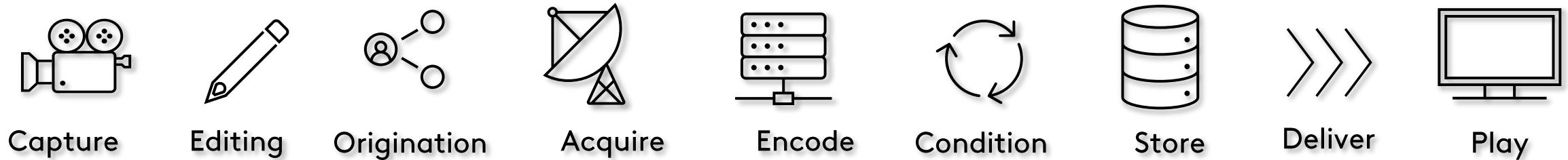
AI offers unprecedented insights and decisioning capabilities in complex workflows and multidimensional data

Content Processing and Delivery Ecosystem is complex requiring optimizations to be made at each stage of the process

AI/ML can help optimize for quality, efficiency, agility, latency, and cost across the entire pipeline from content creation to end user playback & enable new innovations in user experiences



# Video Ecosystem



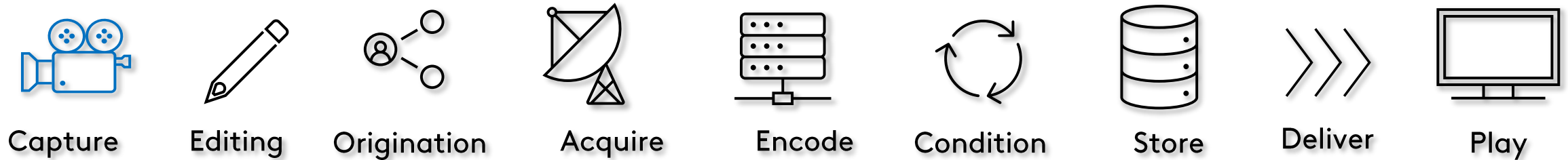
Content undergoes and traverses many processes.

Content is:

- Captured and pre-processed for delivery for both Live and non-Live use cases
- Edited for delivery and storage
- Originated as a live stream or channel
- Acquired by distribution partners
- Transformed into variants through re-encoding/transcoding for delivery to different devices and mediums
- Conditioned for storage and delivery
- Stored for playback
- Delivered through CDNs, Satellite, and other channels to clients
- Played back on ever growing set of hardware and software devices

AI/ML opens broad sets of new innovations and optimizations across all these stages

# Adding Intelligence across the Content Ecosystem

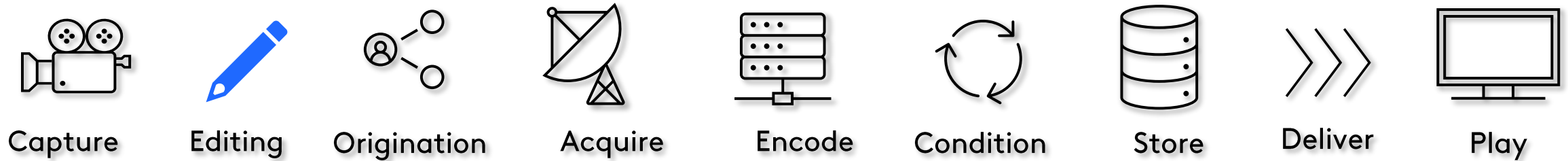


Immersive understanding of the scene at the point of capture

- Camera Parameters
- Time/Location
- Analysis of scene on/near device
- Skeletal Tracking using Motion Capture and AI Models
- Detailed Scene Analysis
- Xfinity Home - Analysis at the Edge



# Adding Intelligence across the Content Ecosystem



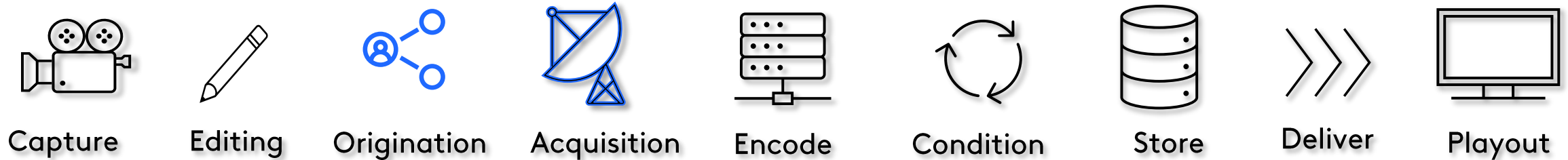
Improve complex content editing workflows using AI assisted technologies

## Content Segmentation using VideoAI™

Automatically Identify key elements of the video

- Ad Breakpoints
- Bars & Tones
- Slates
- Program Segments (e.g. Intro, Credit, Ads)
- Dub Cards

# Adding Intelligence across the Content Ecosystem



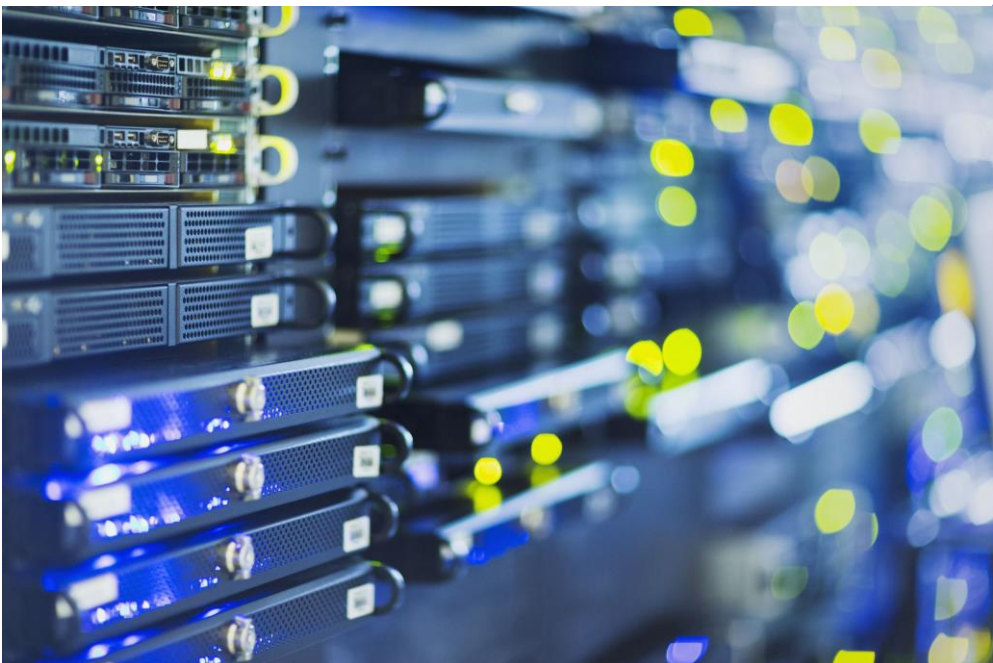
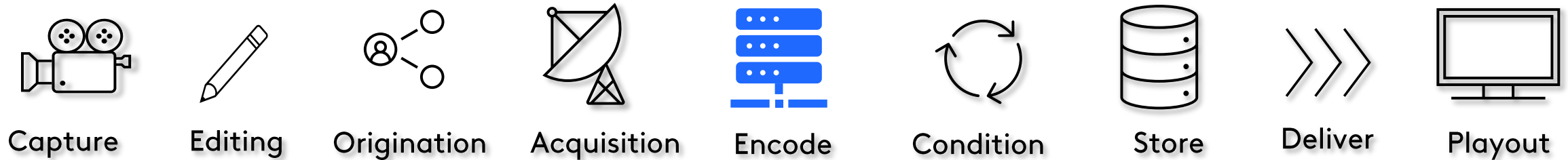
**Overwatch** : AI assisted Master Control Operations for Linear Origination

From 24/7 “Eyes on Glass” to Exception Handling

AI System Automatically Identifies

- 20+ SLA impacting traffic schedules issues
- Raise Alarms on 10+
  - Video Issues
  - Caption issues
  - Audio issues

# Adding Intelligence across the Content Ecosystem



## *Content Adaptive Video Bitrate Selection*

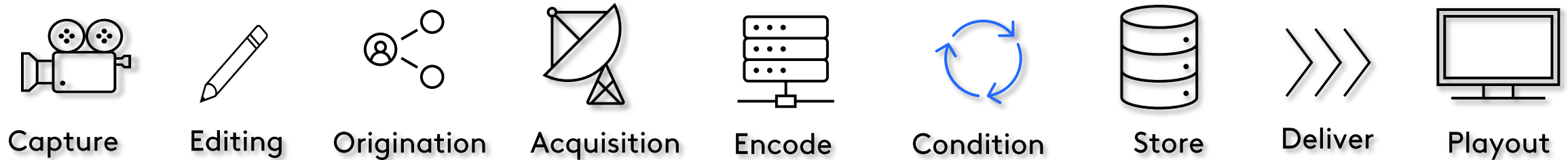
Model to select optimal bitrate for a desired video quality level achieved 95% accuracy

Reduced computational costs by 90%+

Efficient use of available Network Bandwidth

Important as demand for higher resolution and higher fidelity content becomes more ubiquitous

# Adding Intelligence across the Content Ecosystem



## Contextual Advertisement

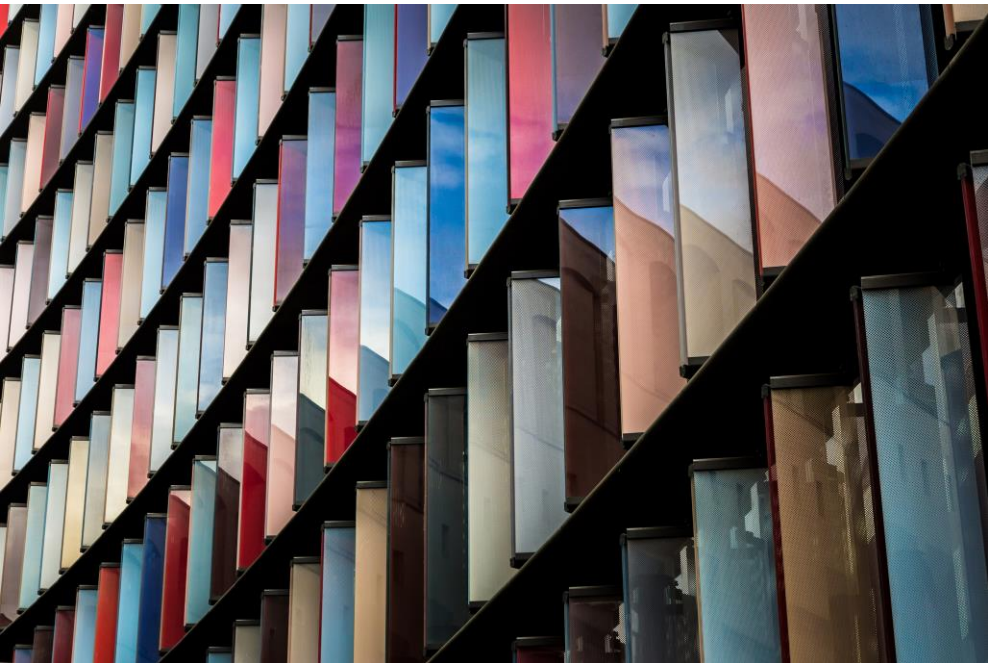
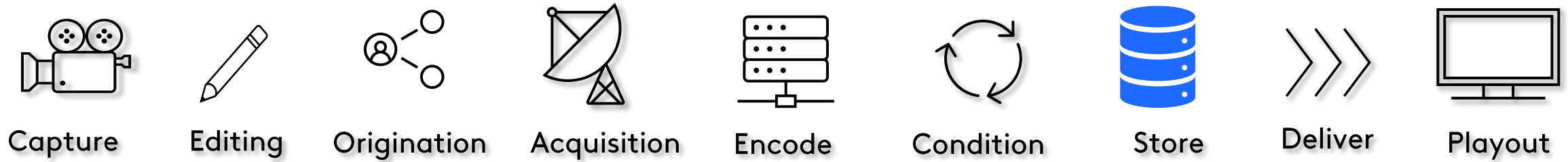
Monetize valuable Ad space with highly relevant advertisements

Enable better Ad-Decisioning to place the most relevant and valuable ads at the right time in each break

SCTE-35 Position Refinement

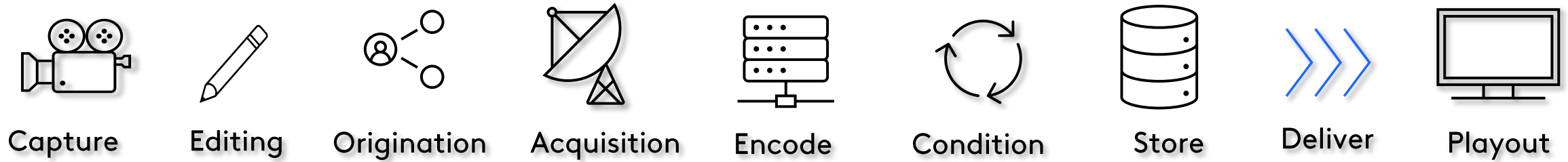


# Adding Intelligence across the Content Ecosystem



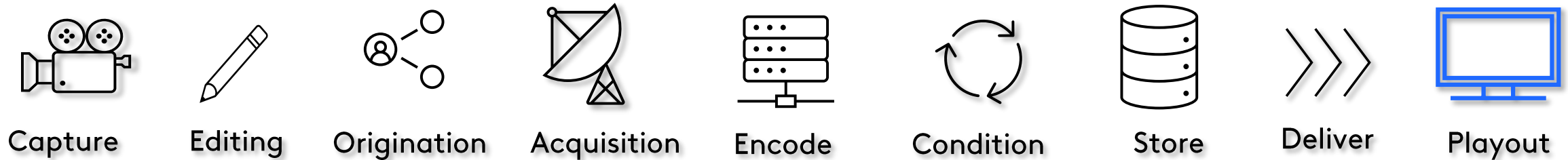
- Identifying Duplicates and Near-Duplicates across content libraries
- Optimize Storage
- Optimized workflows to reduce unnecessary/redundant QA tasks
- Automatically Extend DVR Recording

# Adding Intelligence across the Content Ecosystem



- CDN selection based on playback & network analytics
- Intra CDN routing decisions based on network health
- AI/ML Informed Pre-Positioning of Content
- Video Piracy Detection

# Adding Intelligence across the Content Ecosystem



sky sports SKY SPORTS RECAP

8' Georginio Wijnaldum Goal

11' Issa Diop Goal

24' Sadio Mané Shot

LIVE

018

## New LIVE, DVR, & VOD User Experiences

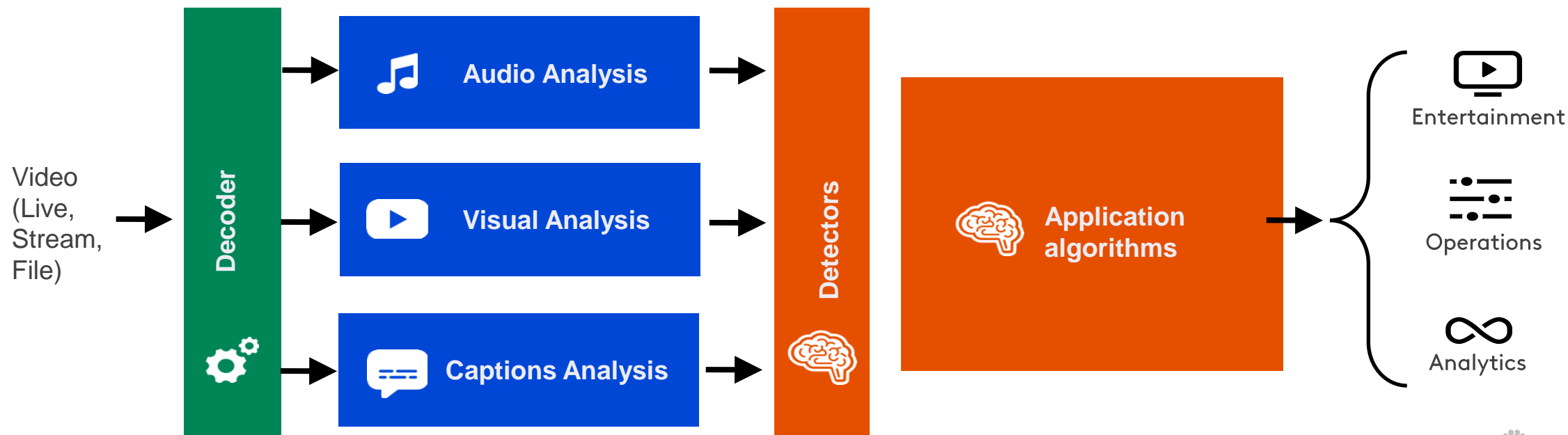
- Xfinity Smart Resume
- Xfinity Sports Highlights
- Sky Sports Recap (Soccer, Cricket, F1, Golf)
- Peacock Explore
- Intro Skip
- Binge Watching with Credit Rolls

# Media Analytics

Analyze and understand what is happening in the video, audio, and captions moment by moment to create scene level metadata that powers new products and enhances workflows

Computer vision, audio analysis, closed captions analysis, signal processing, machine learning, deep learning, and more to understand what's happening in the moment

Media Analytics Framework (MAF)  
Scalable, Extensible, and Adaptive Approach to multimodal understanding of Media





# Media Understanding across Dimensions

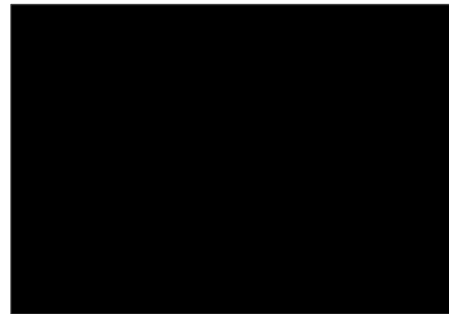


## TECHNICAL



Black Frame/Slug

## STRUCTURAL



Shot Boundary

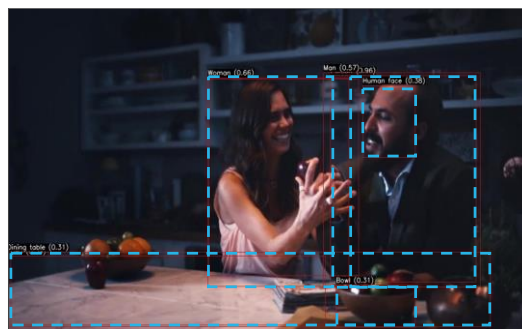
Black Frame

Shot Boundary

## DETECTION



Weekend Update



Speech, Female Speaker, Monologue, Applause

## SEMANTIC UNDERSTANDING



Two women standing in Gym, Fitness Area

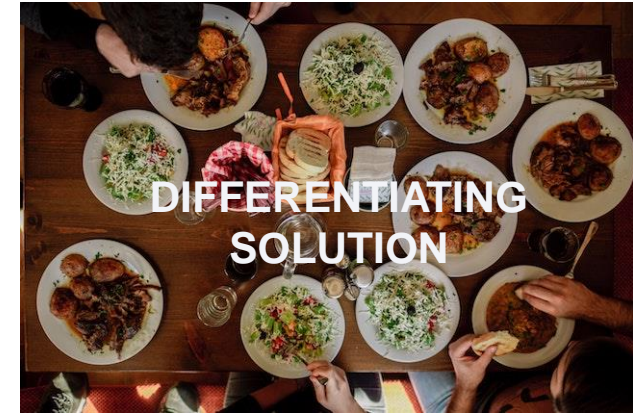
# Taking Advantage of the Accelerating Pace of AI Innovation



- People/Places/Things
- Audio Characteristics
- Text Recognition
- Logo Detection
- Video Events
- Topics
- ... more



- Rule Based
- Statistical
- Heuristics/Domain Based
- Machine Learning
- AI/Deep Learning
- Generative AI & LLMs



- Content Segmentation
- Automated Chaptering
- Contextual Advertisement
- Binge Watching
- Sports Highlights
- Dynamic Ad Insertion
- Media Operations
- Deep Search & Discovery
- AI Assisted Video Quality Monitoring
- ... more

# Media Analytics at Scale in Comcast

xfinity

sky

peacock

  
COMCAST  
NBCUNIVERSAL

COMCAST  TECHNOLOGY SOLUTIONS

# VideoAI™ from Comcast Technology Solutions

Built upon the MAF Platform

Software as a Service (SaaS) offering available to customers and partners

Built on Comcast's deep domain knowledge and extensive experience in entertainment media

Bringing in-house technology already in production to the media industry



# Media Analytics in Comcast & VideoAI



2023 Emmy Technology Award Winner  
for AI-ML curation of Sports Highlights



# Generative AI

Automatic captioning for accessibility

Creating visual descriptive tracks for visually impaired

Creating enriched synopses for better search and catch up

In-content Brand placement

Improvements to existing solutions like contextual ads

**Thank You**