

Prime Video

An Amazon Perspective

Future Video Coding



Overview

1. Video at Amazon

- Example of our applications

2. Lessons Learned

- Insights and suggestions for future video coding standards

3. AI and next generation standards

- The role of neural networks and machine learning in video coding standards

Prime Video

Video at Amazon

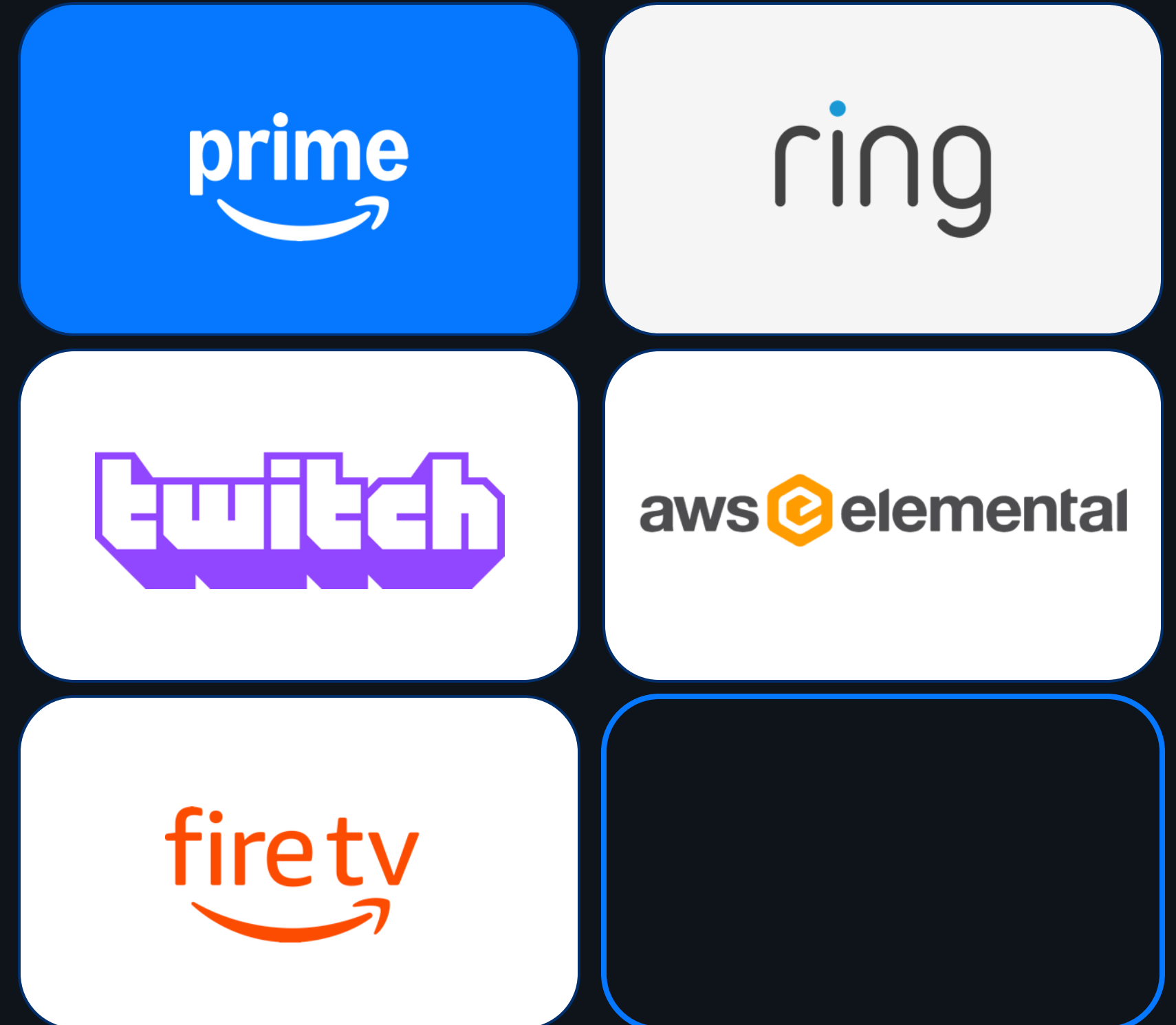


Example Applications

Amazon has a number of use cases that gives a broad perspective on video coding requirements.

- Prime: Over-the-top content delivery
- AWS Elemental: Cloud based video compression
- FireTV: Digital media players
- Ring (and Blink): Home security and smart home devices
- Twitch: Live streaming platform and streaming solutions

... and others.



Example Applications

Each considers a variety of customer experiences and content types.

Examples from Prime:

- Subscription Video on Demand (SVOD)
- Transactional Video on Demand (TVOD)
- Advertising Supported Video on Demand (AVOD)

Content types

- Episodic and Movie content
- Live content
- Advertising content
- Original content (Amazon Studios) as well as third party content. For example, the Super Bowl is available via a subscription to Paramount Plus.



amazon ads



Example Applications

Highlight that exclusive streaming of live sports is a rapidly growing application.

Prime Video provided a number of live streaming of events. Examples include:

- NBA League Pass (Worldwide – via a Third Party Add-On Subscription)
- Thursday Night Football (USA)
- NHL Prime Monday Night Hockey (Canada)
- UEFA Champions League Football (Germany, Italy, the United Kingdom & Ireland)
- Roland-Garros Tennis (France)
- Wimbledon (Germany and Austria)
- Premier League (Sweden and Denmark)
- New Zealand Cricket (India)

The TNF events average 13+ million viewers



Development Insights

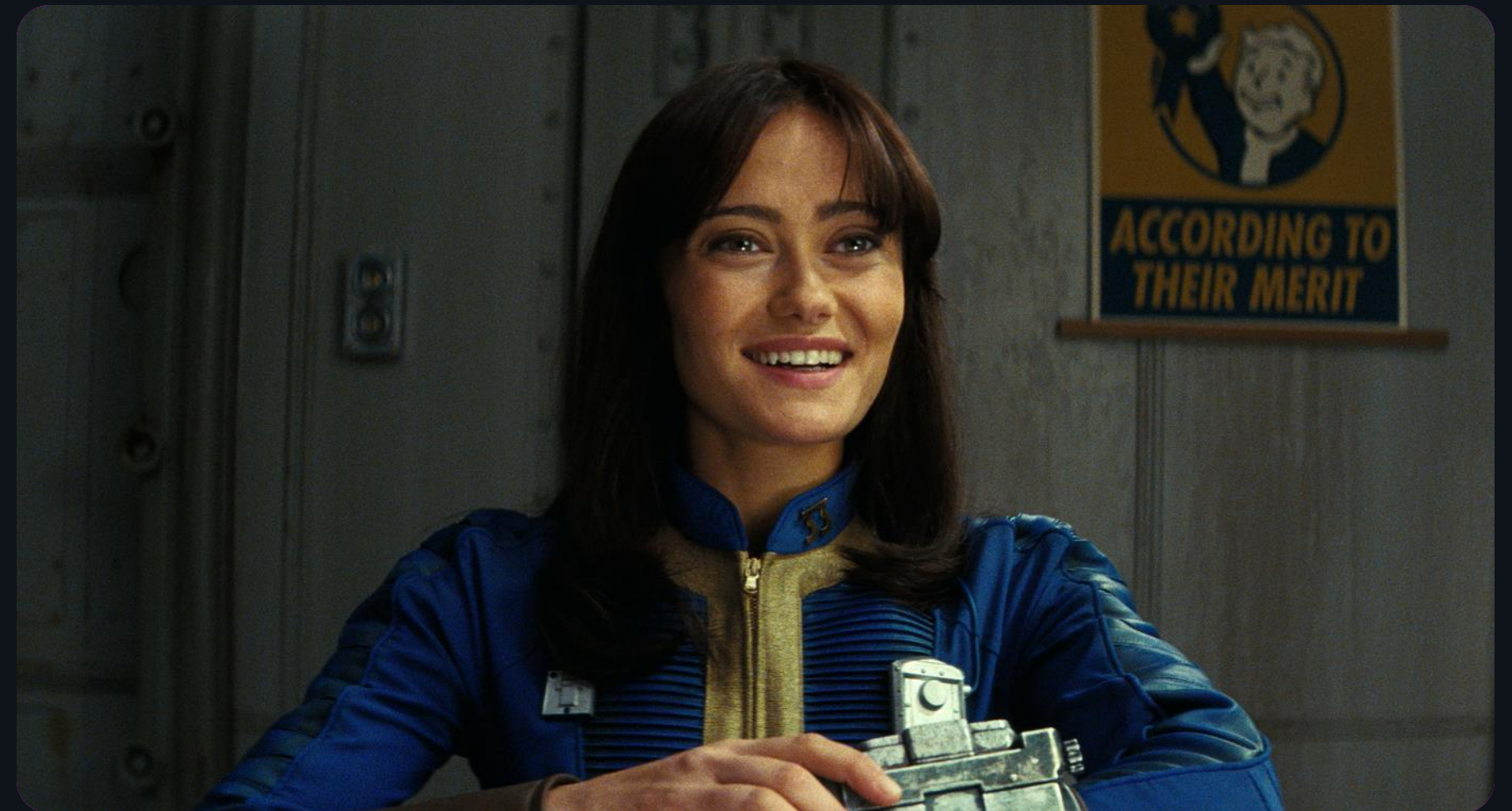


Development Insights

From our experiences with different applications and use cases, we want to present a number of insights and suggestions for future video coding development.

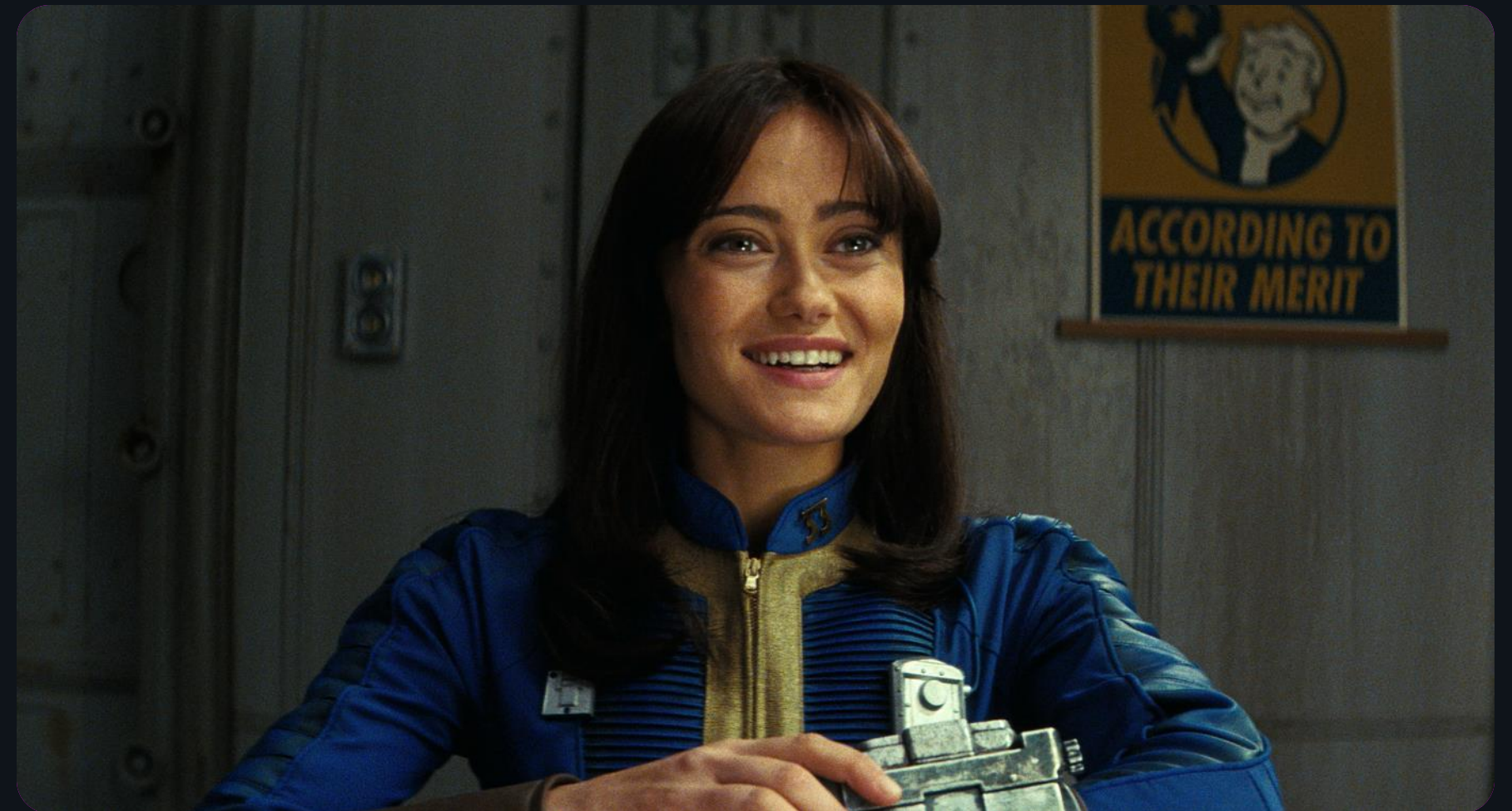
Film Grain and Synthesis

- We observe that film grain is present in both legacy and modern content – and expect its continued use in the creative process
- Delivering this information to our customers is highly desirable
- This currently requires a significant number of bits to code and transmit



Film Grain and Synthesis

- Film grain synthesis provides a meaningful benefit for these applications
- For a practical deployment though – the synthesis operation must be normative and part of the conformance point
- We would also encourage evaluating the overhead of film grain metadata (or other metadata) in low bit-rates



Adaptive Bit-rate Streaming: Coding Efficiency

- Adaptive bit-rate approaches are common in video streaming applications
- The approaches rely on closed GOPs and use lower resolution renditions at lower bit-rates
- We encourage designing toward this coding approach during development and testing (both subjective and objective)



Live Streaming: Enhanced sub-pictures

- Showing multiple video streams (simultaneously) is growing in popularity
 - Ability to follow multiple games at the same time
 - Arrangement of the streams in different layouts and with different resolutions
- We encourage the group to consider this use case when evaluating decoder complexity



Live Streaming: Error Resilience

- Live streaming is a growing application that relies on UDP delivery
 - Amazon proprietary protocol
 - Media over QUIC
- Error resilience is important as are methods to control drift
- Improving the coding efficiency of IDR-frames is helpful for ultra low-latency use cases



Low light content

- We observe that coding tools are not well optimized for coding low light regions
- Encourage including content with these properties during testing and evaluation



Banding

- Our experience is that compression efficiency is often limited by banding artifacts
- We observe these artifacts differ in HDR and SDR content
 - HDR: appearing in the brightest low-gradient regions
 - SDR: appearing in the darker low-gradient regions
- Encourage the group to measure those artifacts during development



Visual Quality Metrics

- We observe a continual shift to more advanced visual quality metrics for external codec evaluation
 - VMAF, VMAF NEG, etc.
- Encourage the group to continue evaluating how to incorporate these metrics into the standardization process



AI and Next Generation Standards



AI and Next Generation Standards

- We anticipate and support the inclusion of AI tools into future video coding standards
- We see the configurability of these tools as a major benefit
- We also expect that these tools will benefit from advancements in training procedures even after standardization is complete



AI and Next Generation Standards

We would encourage the group to:

- Ensure these tools are highly configurable and controllable through the bit-stream
- Ensure these tools are reproducible and bit-exact to allow broad deployment
- Include these tools in the conformance point and not treat as meta-data to allow broad deployment



Thank You