



V-NOVA



# Introduction to MPEG-5 Low Complexity Enhancement Video Coding (LCEVC)

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# Outline

- > What is it, how it works and performances
- > How LCEVC can benefit broadcast scenarios
- > Adoption and deployments
- > How it can be tested and used

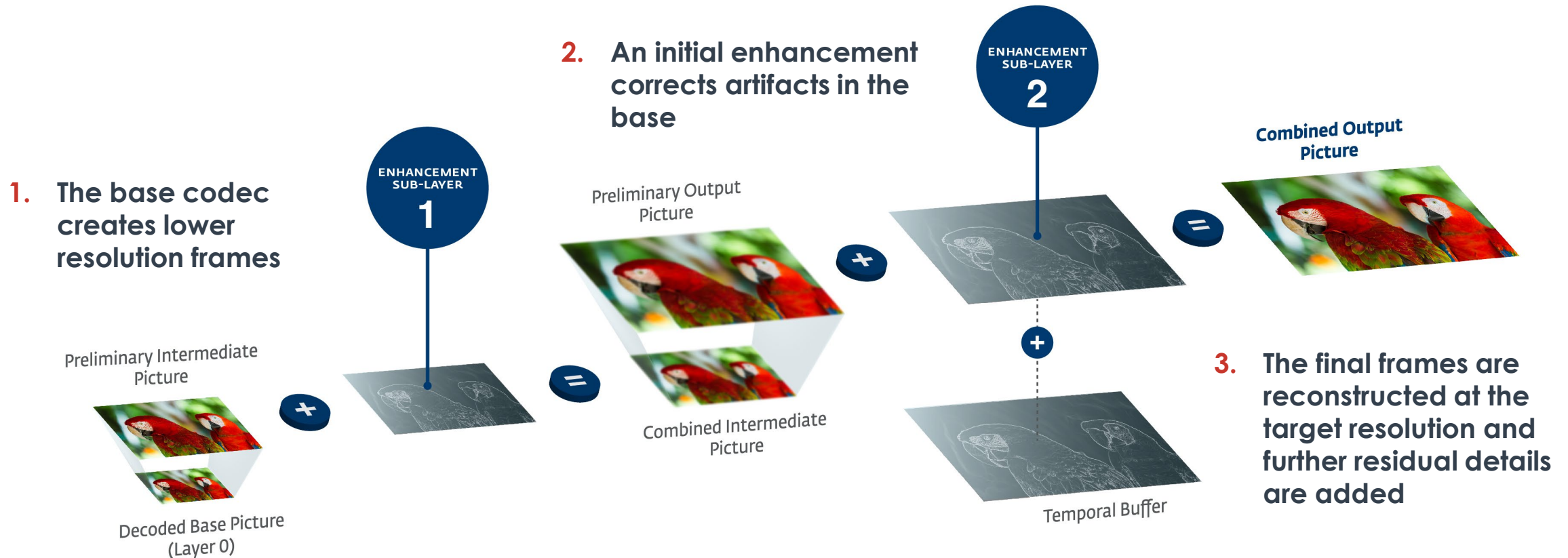


# Low Complexity Enhancement Video Coding



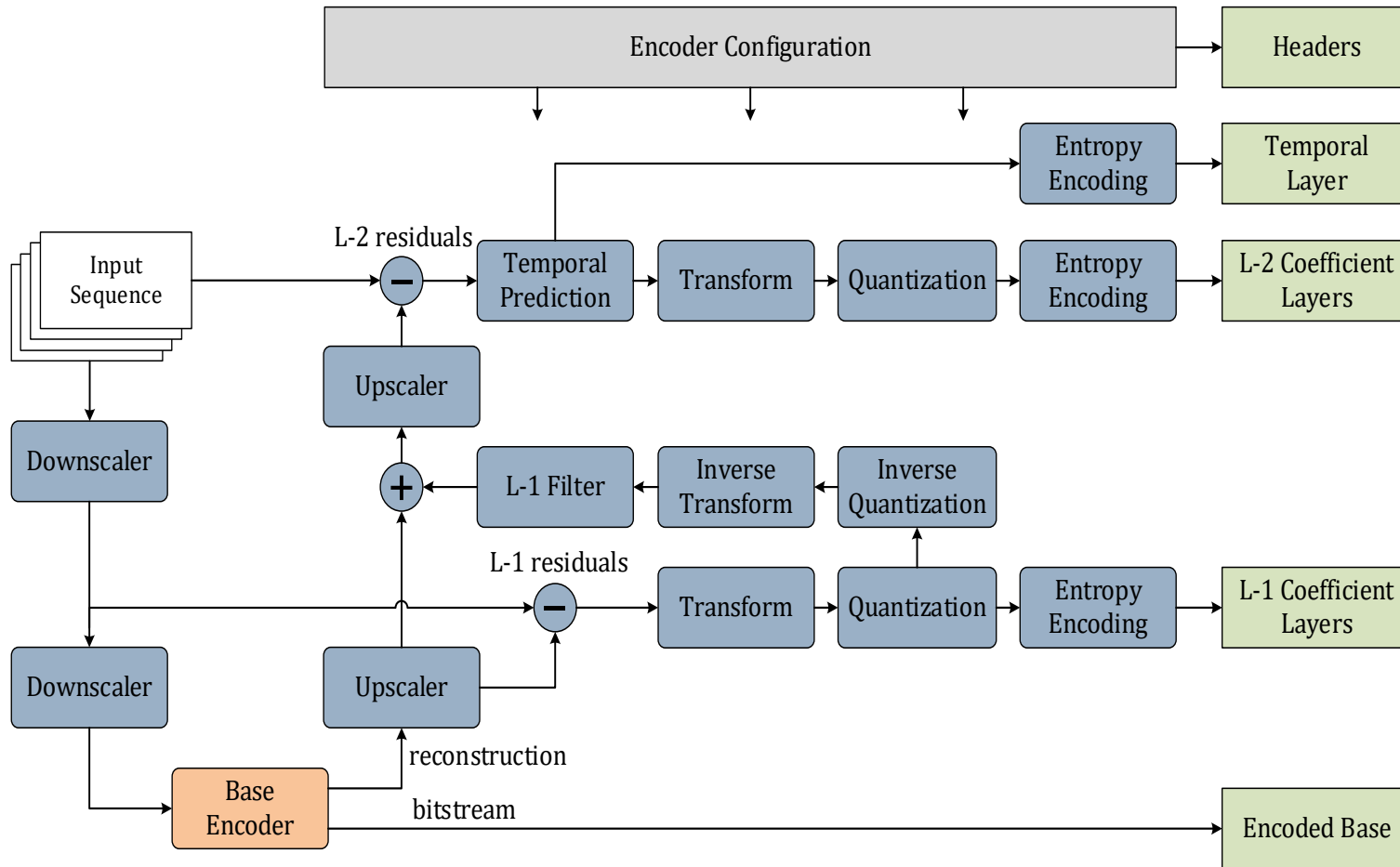
- LCEVC enhances a codec of choice
  - Adds high definition details starting from a low-resolution video encoded with any given codec
  - Improves viewer engagement by increasing visual quality at any given bitrate
- The key design factors include:
  - Codec-agnostic design
  - Software-driven implementation
  - Low-computational tool set
- These factors enable LCEVC to:
  - Avoid disrupting existing ecosystems irrespective of codec(s) in use
  - Simplify transition from older generation to newer generation codecs
  - Reduce power consumption particularly on battery-powered devices

# How LCEVC works: Two layers of enhancement



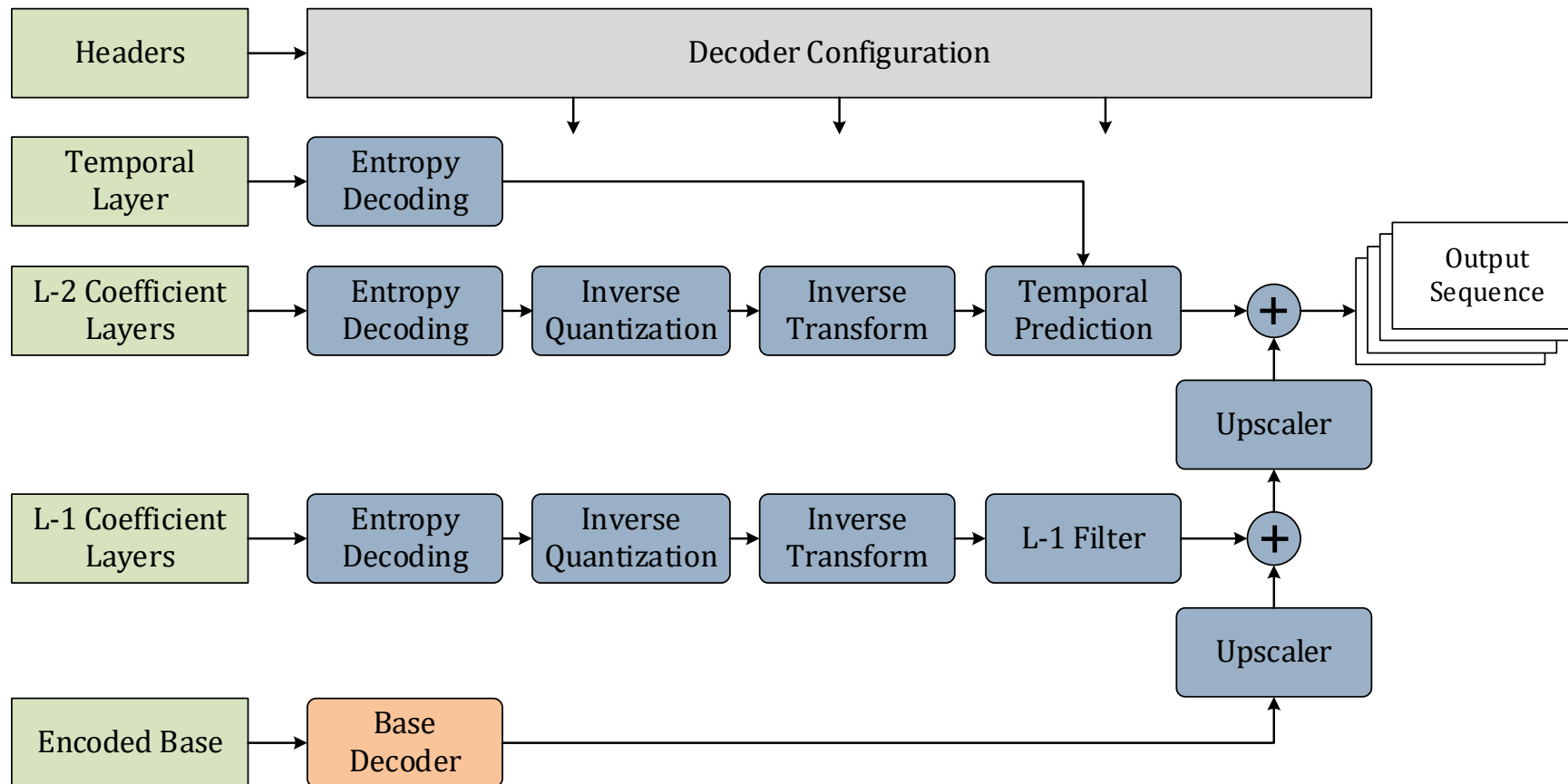
By best exploiting the characteristics of existing codec and the enhancement, LCEVC improves quality and reduces the overall computational requirements of encoding. Importantly, it preserves the original creative intent rather than just upsampling a lower resolution content

# LCEVC Encoder



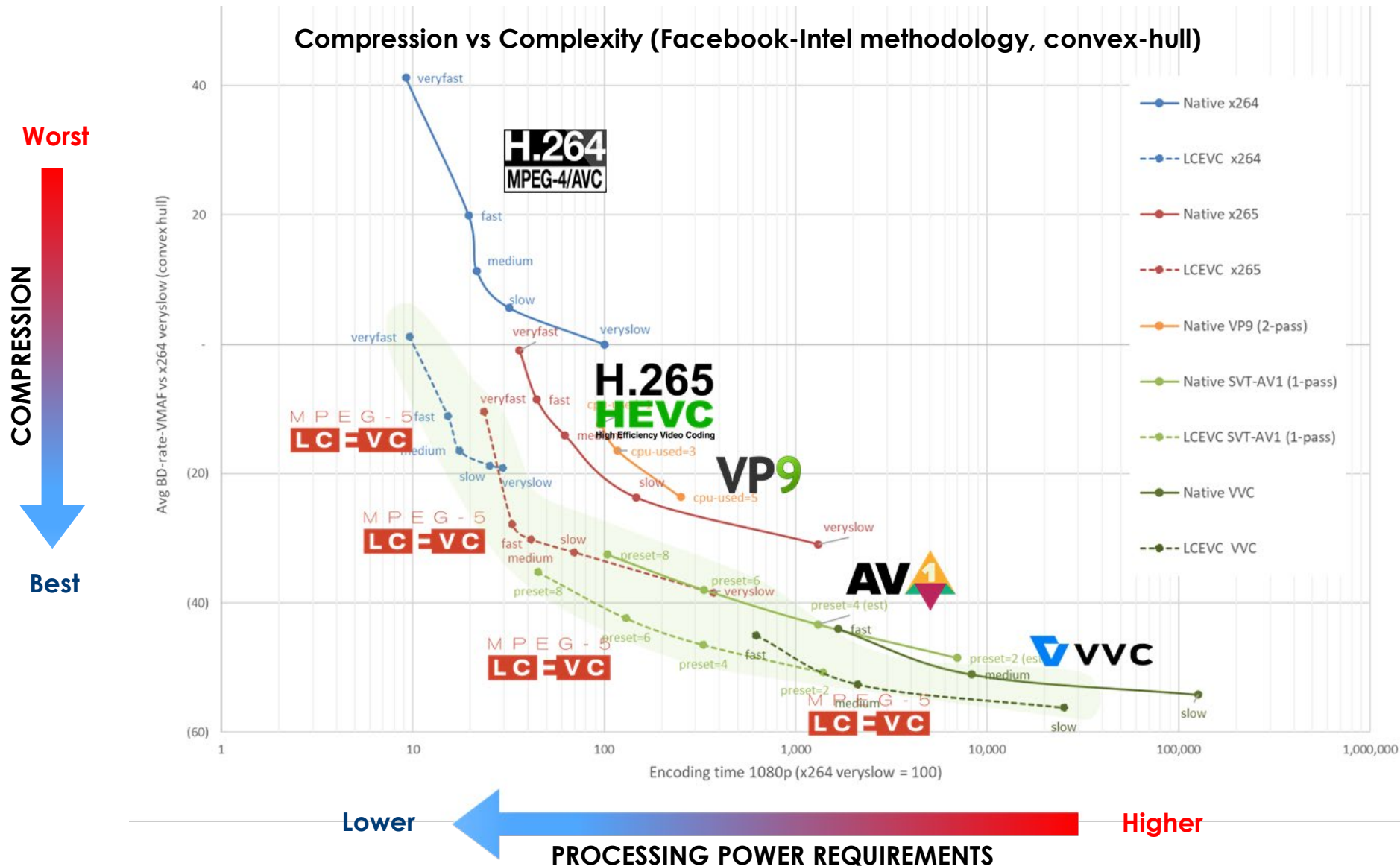
- In addition, the LCEVC format provides flexibility and extensibility:
  - Custom quantization (frame-by-frame)
  - Custom up-scaling
  - Signalled post-processing (e.g.: statistical dithering)
  - Non-normative user data to signal technical (e.g., QoE parameters) or non-technical parameters (e.g., advert position)

# LCEVC Decoder





# LCEVC enhances any video codec



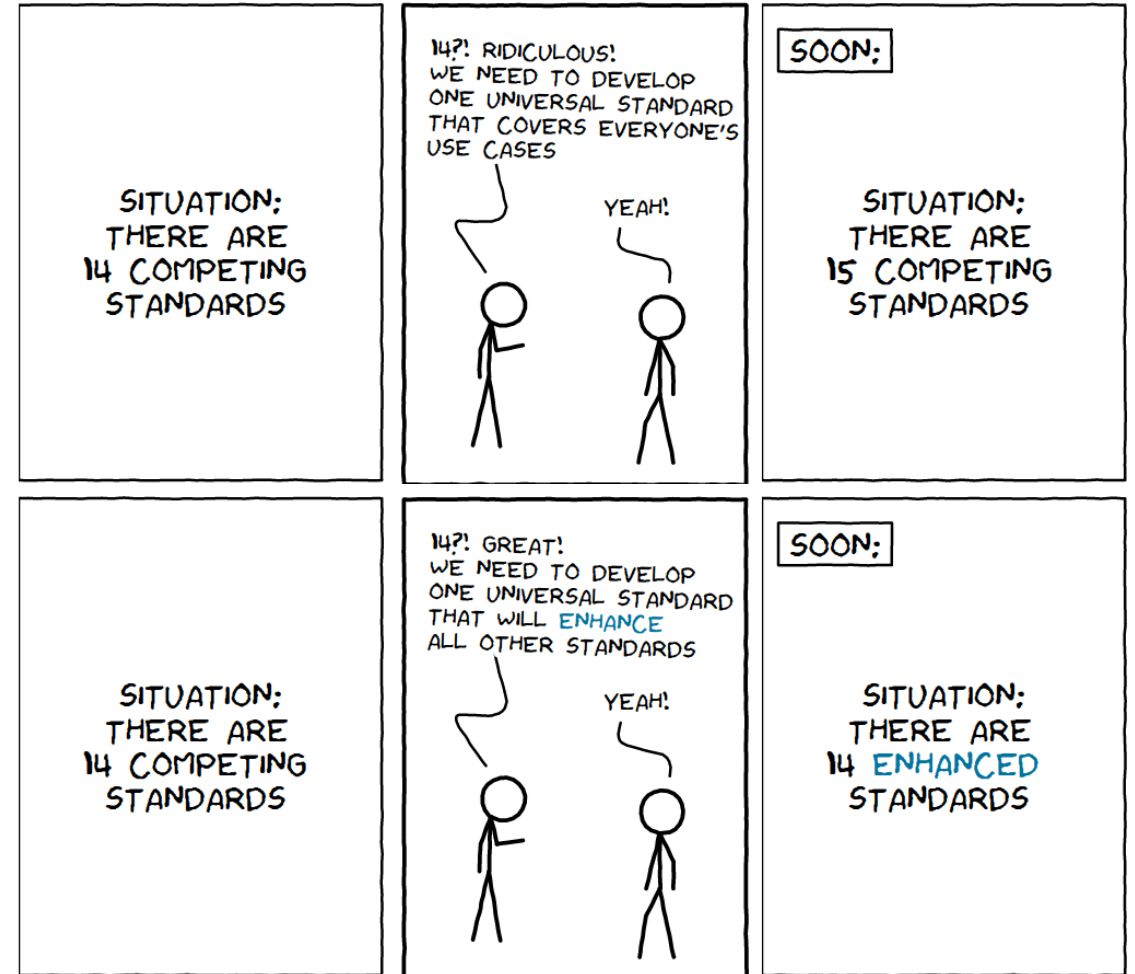
- LCEVC enhances all video codecs available, with different profiles in the compression-complexity trade-off
- Latest-gen codecs require duplication of video workflows (simulcasting) to maintain compatibility with older devices
- While, a single LCEVC-enhanced video can be used also for delivery to both new and older devices.
- LCEVC significantly improves the trade-off for any codec, **using less energy to produce better quality**





# Why LCEVC was developed in this way

- “LCEVC” - Reduce cost of encoding & transmitting
  - Reduce operating costs for service provider
  - Increase quality without requiring more power
  - Make encoding more sustainable
- “LCEVC” – Compatibility with decoding ecosystem
  - Use it without needing to wait and/or replace entire decoding ecosystem
  - Work with all possible codecs - present and future
  - Enhance not just compression, but also features (e.g., bit-depth, SDR-to-HDR, etc.)



# Use case for broadcasting in Brazil



## TV 3.0

Launch date: 2025

UHD-1/UHD-2  
HDR PQ10 & Immersive Audio  
IP-based  
Personalised content

LCEVC + VVC for broadcast & internet  
LCEVC + HEVC/AVC for internet

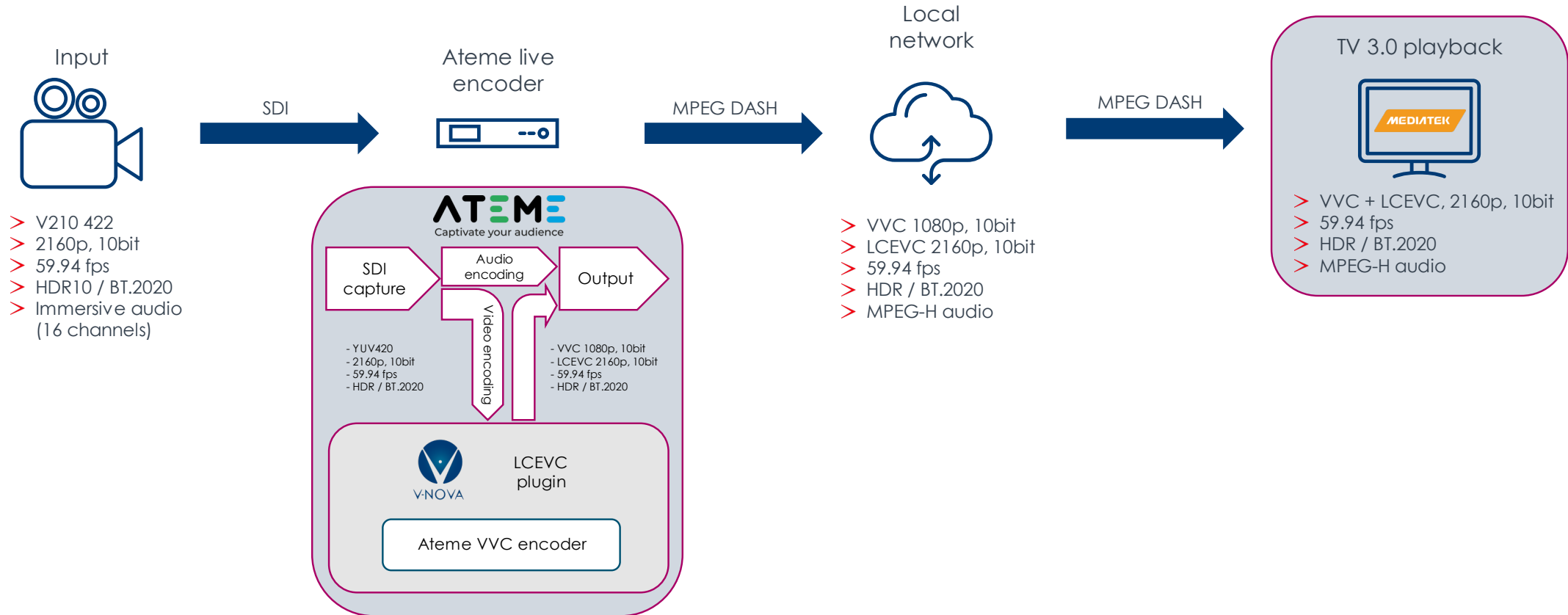
## TV 2.5

Since 2021

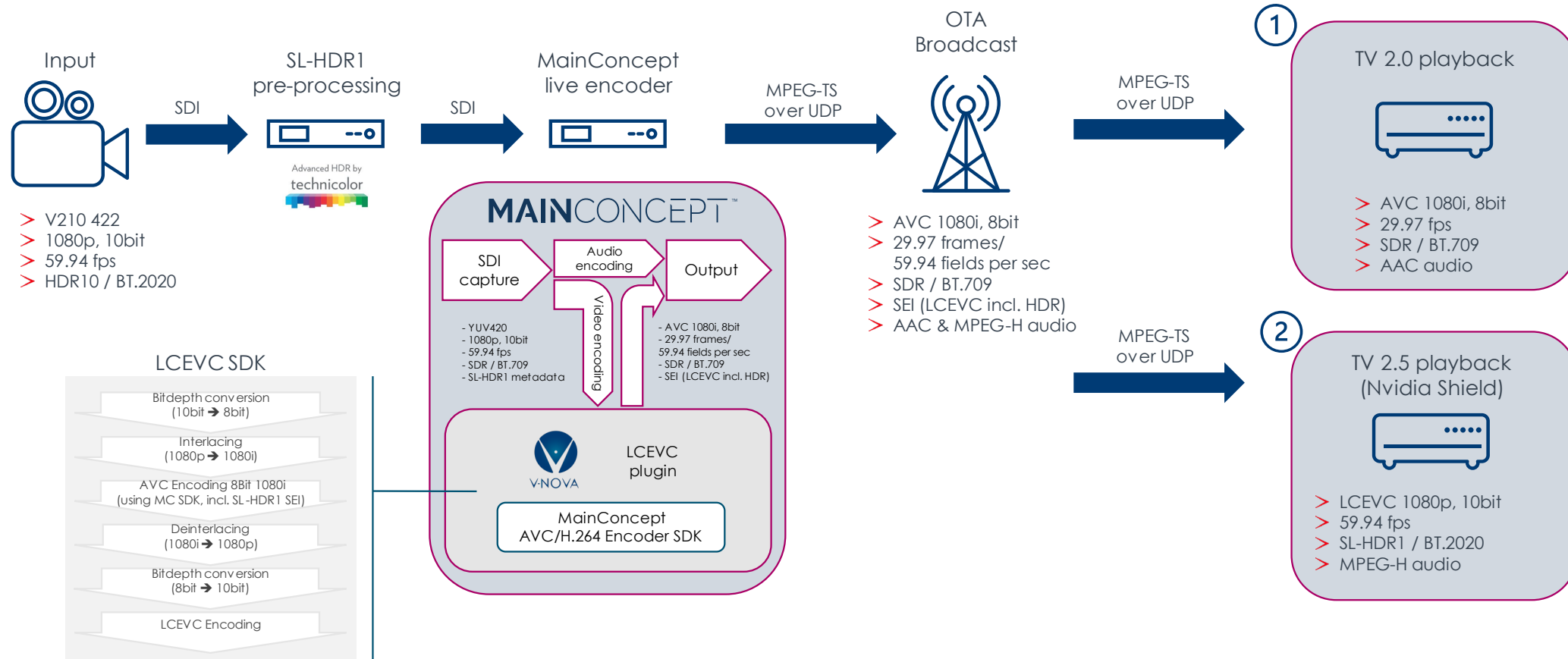
Backward-compatible with TV 2.0 (SDR 1080i)  
Full HD (HDR 1080p)  
Immersive Audio  
DTV Play

LCEVC + AVC

# World Cup 2022 live TV 3.0 demo by Globo



# World Cup 2022 live TV 2.5 demo by Globo



# Use cases for DVB



- Use case 1: broadcast (e.g., DVB-T), enhancing AVC
- Use Case 2: broadcast (e.g., DVB-T2), enhancing HEVC
- Use Case 3: broadband (DVB-I), enhancing AVC

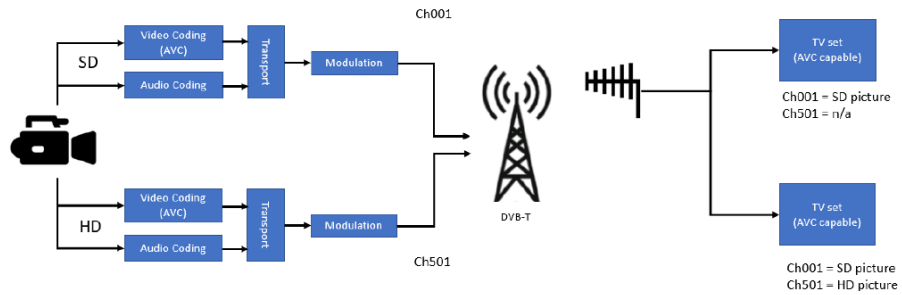


Fig. 4.1 – Simulcasting with AVC

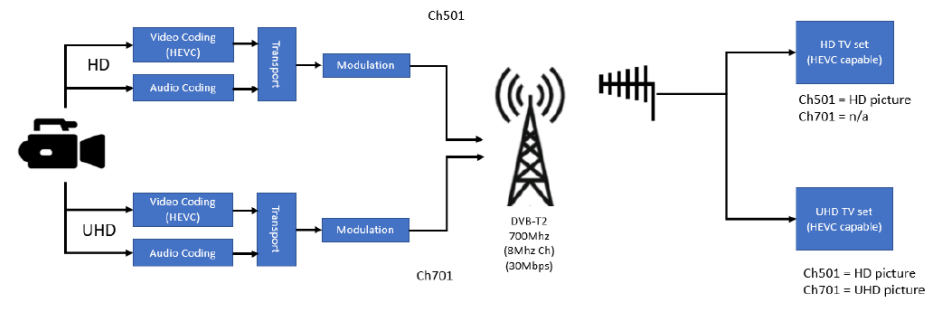


Fig. 4.3 – Simulcasting with HEVC

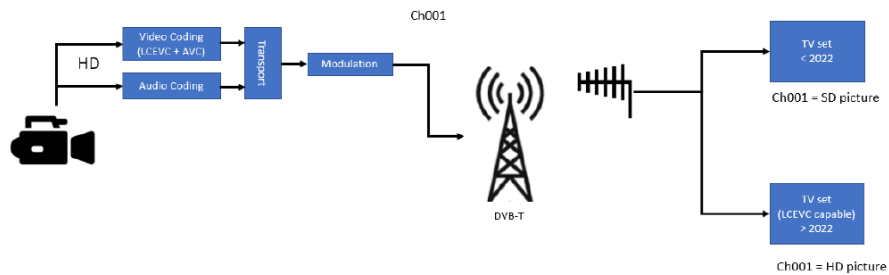


Fig. 4.2 – LCEVC enhancing AVC

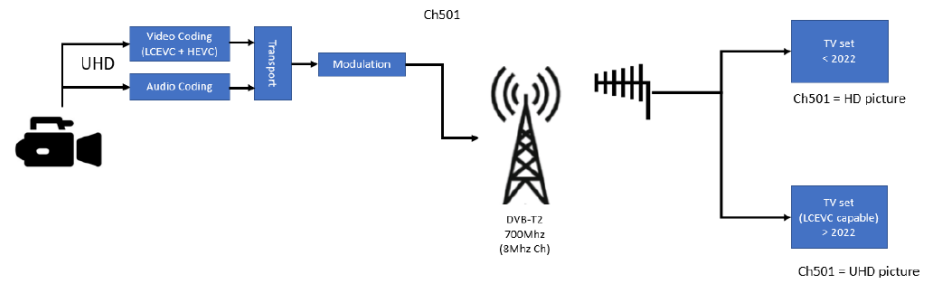


Fig. 4.4 – LCEVC enhancing HEVC

# MPEG-5 LCEVC Deployment Status (as of April 2022)

## Test Model



## Software SDK



## Next-gen TV Systems



## Encoder & Players



## E2E Platforms

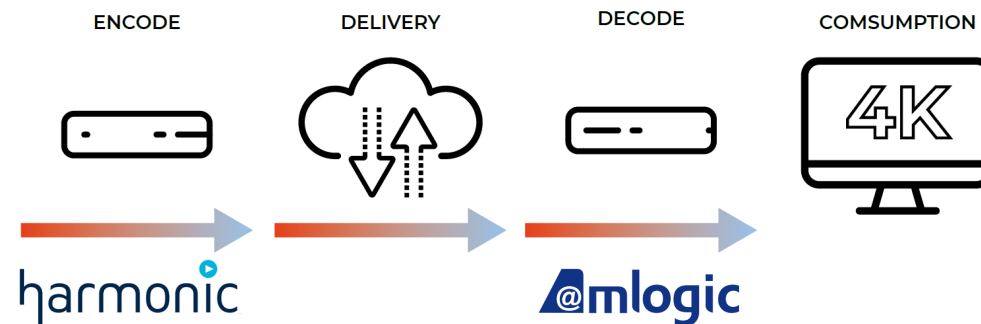


## Chipset/SoC & System Integrators



MPEG-5  
LCEVC

## MPEG-5 LCEVC Showcase



# How you could test it



- Encoder and Decoder SDK available for evaluation from V-Nova
  - FFMPEG, etc.
  - ExoPlayer, etc.
  - Cloud transcoding available at <http://platform.v-nova.com>
    - LCEVC apps are available from V-Nova in the Apple Store, Google Play Store and Windows Store
    - Plug-in free HTML5 demo web pages also available (<http://player.v-nova.com> and <http://experience.v-nova.com>)
- Professional encoder available for evaluation from Harmonic
- A test model is also available for MPEG members
  - However, it does not have possibility to set rate control and it is not real-time
  - Mainly used for evaluation in MPEG (Verification tests available [here](#))



# What's next



- Are there any use cases specific to NorDig which we should consider?
- Are there any tests/PoCs which NorDig members would be interested in exploring/tests?
- DVB use cases: if interested, support in DVB (and current CRs) would be useful to accelerate deployment on DVB-specific scenarios
- There are many streaming applications for which deployment may be possible – if interested, don't hesitate to contact
- Any other questions?

# References



- [www.lcevc.org](http://www.lcevc.org)
- ISO/IEC 23094-2:2021 Information technology – General video coding — Part 2: Low complexity enhancement video coding, 2021. [Online]. Available: <https://www.iso.org/standard/79143.html>
- MPEG specifications, performance evaluations, user guides, product documentation and other LCEVC-related resources," 2021. [Online]. Available: <https://www.lcevc.org/lcevc-resources/>
- G. Cobianchi et al., "Enhancing SVT-AV1 with LCEVC to improve quality-cycles trade-offs and enhance sustainability of VOD transcoding," in Proc. SPIE 12226, Appl. Digit. Image Process. XLV, 2022, Art. no. 122260S, doi: 10.1117/12.2633882
- G. Meardi et al., "MPEG-5 part 2: Low complexity enhancement video coding (LCEVC): Overview and performance evaluation," in Proc. SPIE 11510, Appl. Digit. Image Process. XLIII, 2020, Art. no. 115101C, doi: 10.1117/12.2569246
- Verification test report on the compression performance of low complexity enhancement video coding. ISO/IEC jtc 1/SC 29/WG 04 N0076 (20173), 2021. [Online]. Available: [https://www.mpegstandards.org/wp-content/uploads/mpeg\\_meetings/134\\_OnLine/w20173.zip](https://www.mpegstandards.org/wp-content/uploads/mpeg_meetings/134_OnLine/w20173.zip)
- L. Ciccarelli, S. Ferrara, and F. Maurer, "MPEG-5 LCEVC for 3.0 next generation digital TV in Brazil," Front. Signal Process., vol. 2, 2022, Art. no. 884254, doi: 10.3389/frsip.2022.884254.
- S. Ferrara, et al., "The Next Frontier For MPEG-5 LCEVC: From HDR and Immersive Video to the Metaverse" in IEEE MultiMedia, vol. 29, no. 04, pp. 111-122, 2022. doi: 10.1109/MMUL.2022.3213879



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Thank you

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