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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**  22nd Meeting, by teleconference, 20–28 Apr. 2021 | Document: JVET-V2021 |

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| *Title:* | **VVC verification test plan (Draft 6)** | | |
| *Status:* | Output document approved by JVET | | |
| *Purpose:* | Verification Test Plan text | | |
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# Introduction

This document contains the draft plan for the video verification test to be conducted to verify the coding performance of the VVC Main profile. A formal subjective evaluation will be conducted comparing the VVC Main 10 profile to the HEVC Main 10 profile.

Verification testing is planned with first priority for the following categories:

* HDR UHD (HLG and PQ)

Verification testing is planned with secondary priority for the following categories:

* Screen content (perhaps with 2 HEVC anchors – Main 10 and SCC profiles)
* Scalability
* 4:4:4 content

# Verification test coordination

The coordinators of the VVC verification tests are

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# Test sites

Test sites capable of conducting formal subjective assessments in accordance with ITU-R BT.500-14 are invited to contact the test coordinators for participation in and contribution to the VVC verification tests. Test sites capable of conducting formal subjective assessments in the following categories are sought:

1. HDR-PQ UHD 4:2:0 10 bit, up to 60 Hz
2. HDR-HLG UHD 4:2:0 10 bit, up to 60 Hz

Test sites are invited to apply for conducting subjective assessments in one or more of the categories listed above. For participation in the verification tests, volunteering test sites are mandated to successfully conduct a calibration experiment.

It is intended to conduct the subjective assessment for each category in more than one test site. The score data of the subjective assessments at all test sites are to be collected and aggregated by the test coordinators.

Test sites conducting subjective assessments for the VVC verification tests are reimbursed by a fee of approximately 100€ per test subject per day. Financial contributions from companies and institutions, especially those that have participated in the development of VVC standard, are hereby called for in order to cover the testing fees. It is guaranteed that any such contribution will be used solely toward covering the fees incurred due to verification testing. In order to ensure that no testing facility will profit preferentially from such donations, the total expense will be calculated and then divided equally among companies and institutions who pledge their financial support, up to the maximum amount pledged by any individual company. Each company or institution will be invoiced by the test labs accordingly.

# Test categories, coding conditions, and test sequences

Test cases for high dynamic range (HDR) content are defined for the verification tests. The test conditions and configurations for these cases are defined below.

## High Dynamic Range

The goal of the High Dynamic Range verification test is to evaluate and verify the performance of VVC for content represented with both HLG and SMPTE ST 2084 transfer functions.

### Coding conditions

The following test conditions will be used for the High Dynamic Range verification test.

1. Number of sequences and video resolutions:
   1. About five sequences represented with the HLG transfer function and with a spatial resolution of UHD (3840×2160)
   2. About five sequences represented with the SMPTE ST 2084 transfer function and with a spatial resolution of UHD (3840×2160)
2. Bitstreams
   1. Generated with VTM 12.0 for VVC bitstreams, where the VTM is configured for HDR content according to the configuration defined in JVET-P2011.
   2. Generated with HM 16.23 for HEVC bitstreams, where the HM is configured for HDR content according to the configuration defined in ISO/IEC TR 23008-14:2018.
   3. In addition to a. and b., other VVC and/or HEVC bitstreams generated with encoders that are optimized for subjective quality may be tested if available.
3. Encoding parameters
   1. Fixed QP.
      1. Five bit rate points per sequence covering the whole MOS range as much as possible with QP values for the HM and the VTM. The QPs are to be selected such that the subjectively assessed quality is comparable between the two test models.
   2. Internal bit depth of 10bits for all video resolutions
   3. Coding structure
      1. Random access, RA (Storage/Streaming)
         1. Intra refresh at approximately 1 second intervals.
         2. GOP size 32
         3. Picture reordering allowed.
         4. Motion compensated temporal filtering enabled.
   4. Other settings as in the configuration files, with the Picture Hash SEI deactivated
      1. VTM: Configured for HDR content according to the configuration defined in JVET-S2011.
      2. HM: Configured for HDR content according to the configuration defined in ISO/IEC TR 23008-14:2018.

### HDR HLG test sequences

Based on experts screening of test sequences the following set of sequences is under consideration for evaluation in the verification tests.

Table 1 – HDR HLG test sequences under consideration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test sequence** | **Resolution** | **fps** | **Frames** | **Transfer Function** |
| H3\_AMS01\_3840x2160\_10bit\_420\_HLG (TramBridge) | 3840×2160 | 60 | 600 | HLG |
| H3\_AMS06\_3840x2160\_10bit\_420\_HLG (CanalWithTrees) | 3840×2160 | 60 | 600 | HLG |
| RiverByBoat\_3840x2160\_60fps\_10bit\_HLG\_420\_type2 | 3840×2160 | 60 | 600 | HLG |
| C07\_DramaSea | 3840×2160 | 60 | 600 | HLG |
| C16\_PaddockFollow | 3840×2160 | 60 | 600 | HLG |

A selection of proposed QP points was generated and reviewed in a session of experts. The proposed QP settings are listed in the Table below.

Table 2 – Proposed QPs for HDR HLG test sequences under consideration

|  |  |  |
| --- | --- | --- |
| **Sequence** | **HM QPs** | **VTM QPs** |
| H3\_AMS01\_3840x2160\_10bit\_420\_HLG (TramOnBridge) | 41, 37, 33, 29, 25 | 43, 39, 35, 31, 27 |
| H3\_AMS06\_3840x2160\_10bit\_420\_HLG (CanalWithTrees) | 40, 37, 33, 30, 26 | 42, 39, 35, 32, 28 |
| RiverByBoat\_3840x2160\_60fps\_10bit\_HLG\_420\_type2 | 44, 40, 36, 33, 29 | 47, 43, 39, 35, 31 |
| C07\_DramaSea | 39, 35, 31, 26, 21 | 41, 37, 33, 29, 24 |
| C16\_PaddockFollow | 42, 37, 31, 27, 23 | 45, 40, 35, 30, 26 |

### HDR PQ test sequences

A set of HDR-PQ candidate test sequences was visually evaluated in multiple online meeting together with JVET experts. The evaluated sequences were:

Table 3 – HDR PQ test sequences under consideration

|  |  |  |  |
| --- | --- | --- | --- |
| **Test sequence** | **Resolution** | **fps** | **Frames** |
| Chimera HDR5 (DrivingPOV\_HDR) | 3840×2160 | 60 | 600 |
| Meridian HDR2 (Car) | 3840×2160 | 60 | 600 |
| Meridian HDR5 (Beach) | 3840×2160 | 60 | 600 |
| Sparks DirtLot | 3840x2160 | 60 | 600 |
| Sparks Welding | 3840x2160 | 60 | 600 |

A selection of proposed QP points was generated and reviewed in a session of experts. The proposed QP settings are listed in the Table below.

Table 4 – Proposed QPs for HDR PQ test sequences under consideration

|  |  |  |
| --- | --- | --- |
| **Sequence** | **HM QPs** | **VTM QPs** |
| Chimera HDR5 (DrivingPOV\_HDR) | 42, 35, 31, 25, 20 | 45, 38, 32, 28, 22 |
| Meridian HDR2 (Car) | 35, 31, 27, 24, 20 | 38, 34, 30, 26, 22 |
| Meridian HDR5 (Beach) | 36, 32, 28, 24, 20 | 38, 34, 30, 26, 22 |
| Sparks DirtLot | 42, 36, 31, 25, 20 | 44, 38, 33, 27, 22 |
| Sparks Welding | 42, 36, 31, 25, 20 | 44, 38, 33, 27, 22 |

### Timeline and methodology for selection of candidate test sequences

1. Dry-run experiment for confirmation of the chosen QP settings
2. Formal verification tests for the HDR-HLG (if possible under COVID conditions)
3. Report on activity by input document to the 23rd JVET meeting.

# Encoding results

## High Dynamic Range

### HDR HLG test sequences

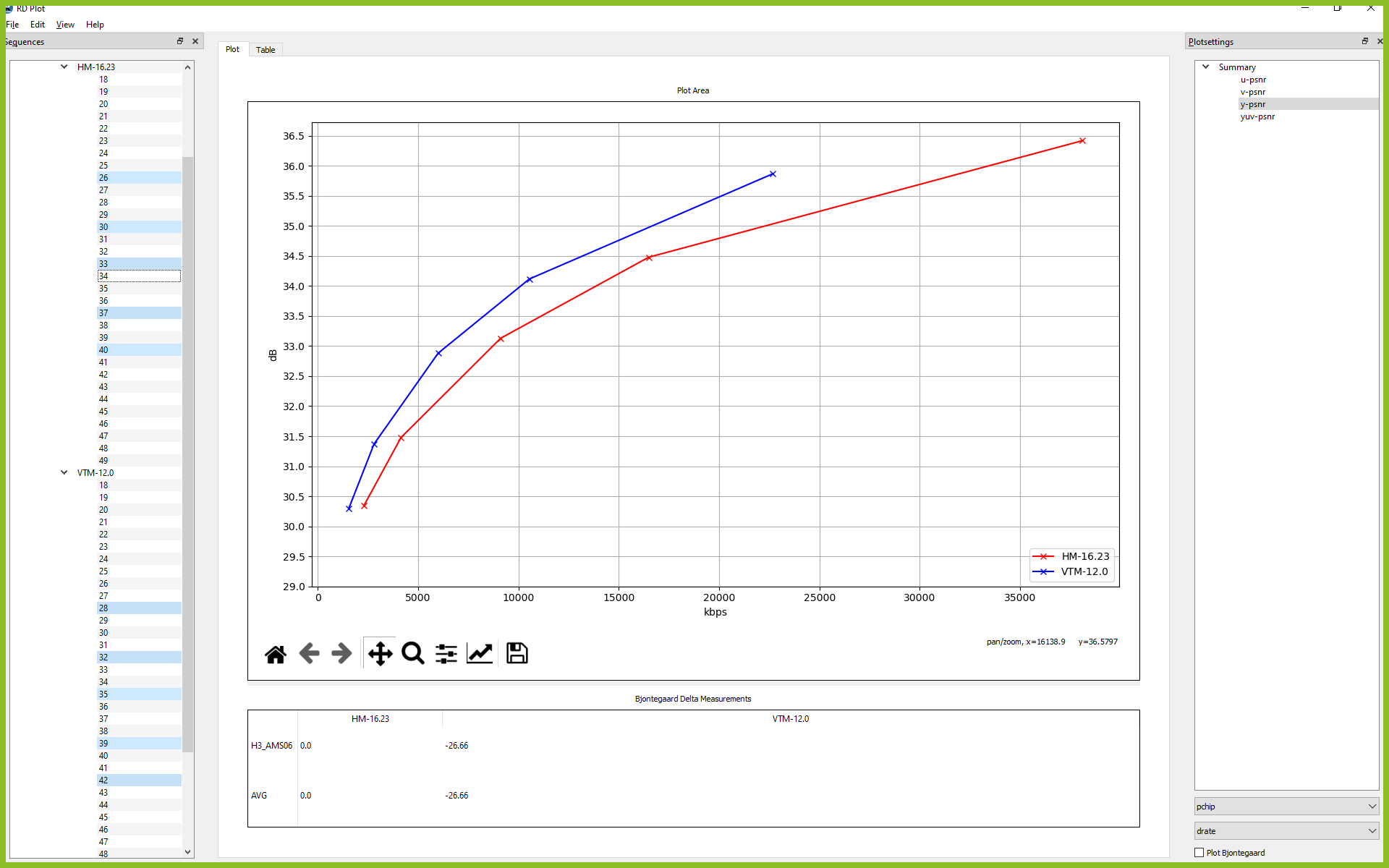
Table 5 – Preliminary PSNR-Y BD rate savings for the HDR HLG test sequences

|  |  |
| --- | --- |
| **Test sequence** | **Y-PSNR BD rate savings** |
| H3\_AMS01\_3840x2160\_10bit\_420\_HLG (TramOnBridge) | 31.93% |
| H3\_AMS06\_3840x2160\_10bit\_420\_HLG (CanalWithTrees) | 26.66% |
| RiverByBoat\_3840x2160\_60fps\_10bit\_HLG\_420\_type2 | 31.30% |
| C07\_DramaSea | 24.57% |
| C16\_PaddockFollow | 38.77% |

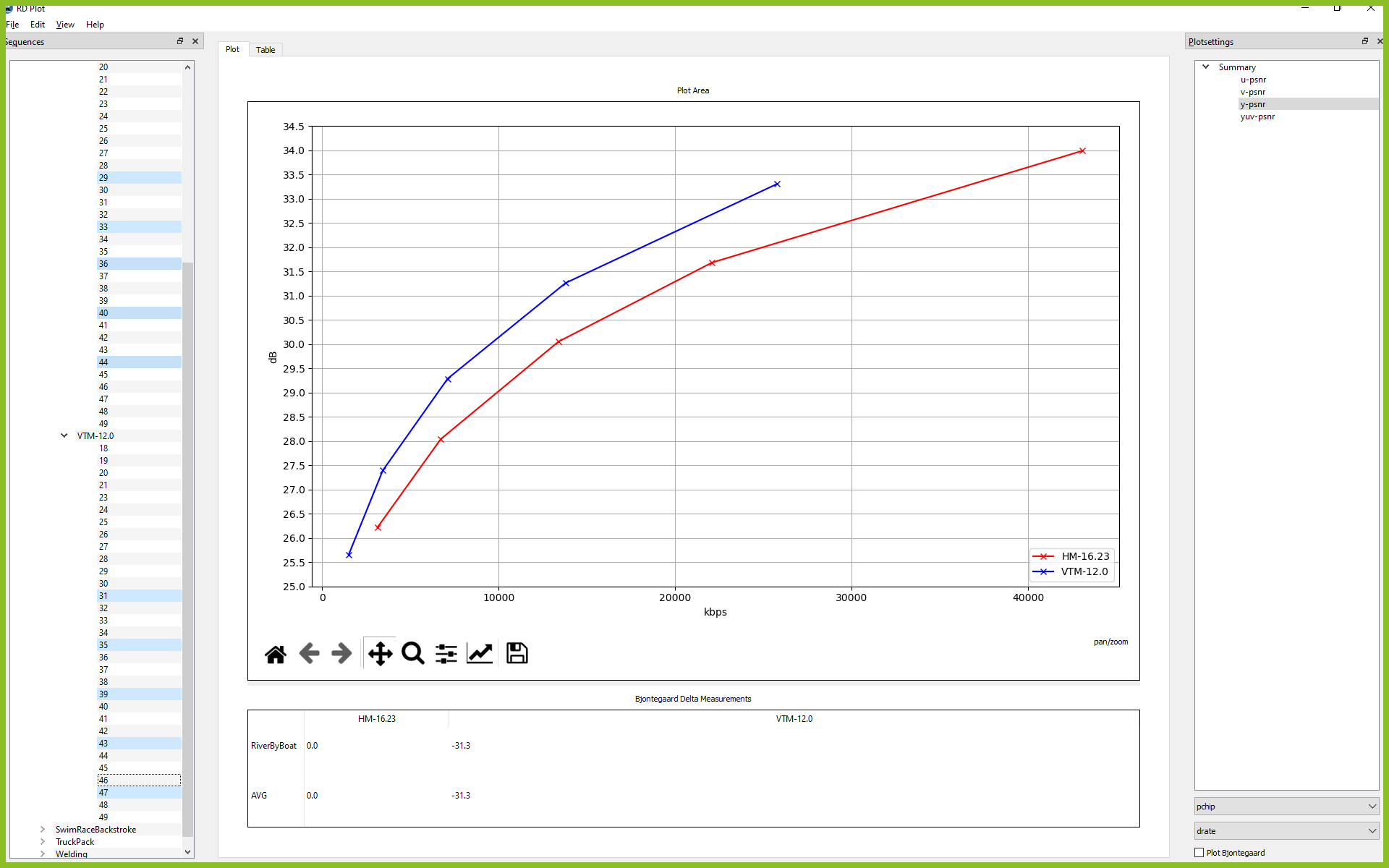
#### H3\_AMS01

### 

#### H3\_AMS06



#### RiverByBoat



#### C07\_DramaSea

### Graphical user interface, chart Description automatically generated

#### C16\_PaddockFollow

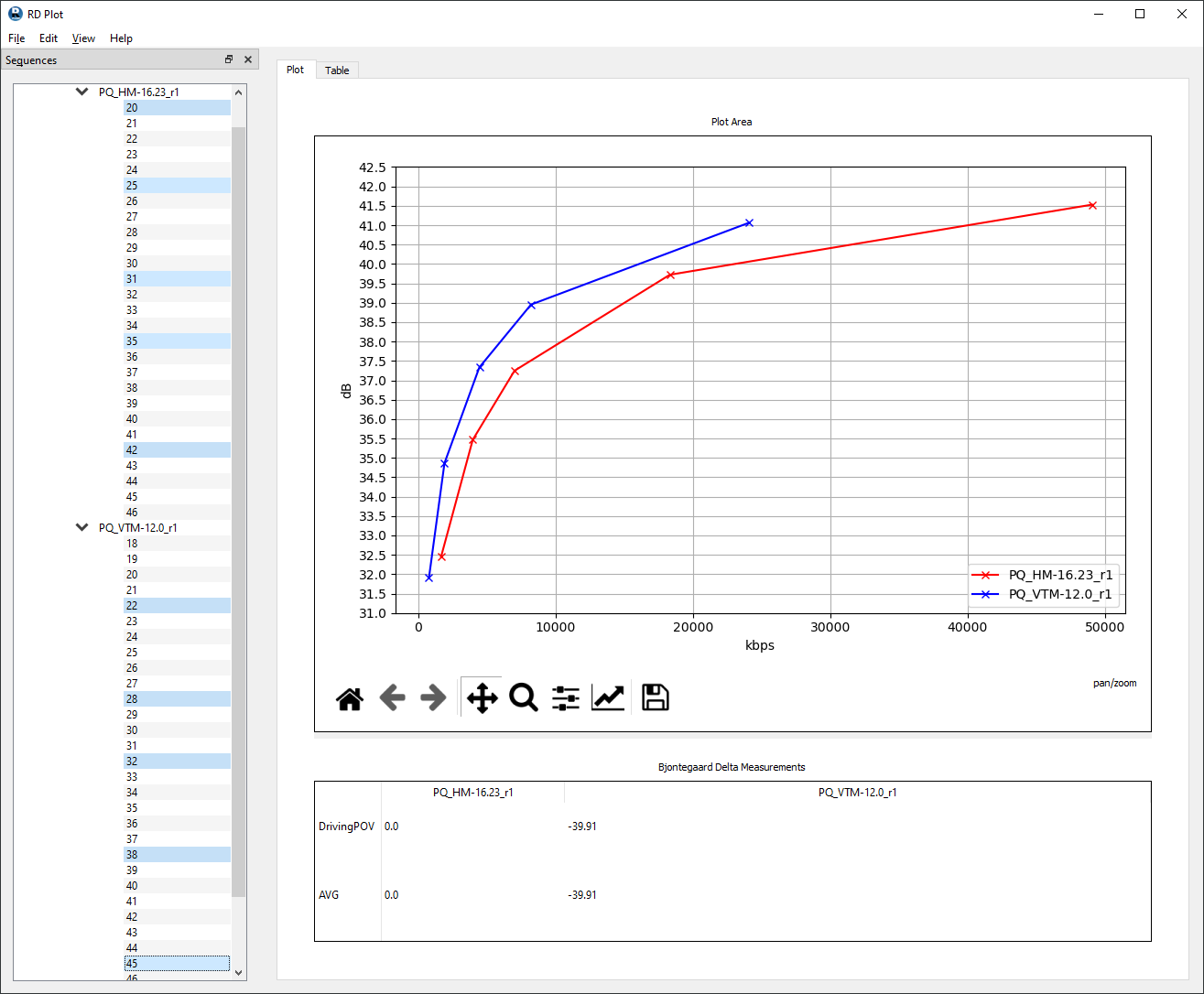
### Chart Description automatically generated

### HDR PQ test sequences

Table 6 – Preliminary PSNR-Y BD rate savings for the HDR PQ test sequences

|  |  |
| --- | --- |
| **Test sequence** | **Y-PSNR BD rate savings** |
| Chimera HDR5 (DrivingPOV\_HDR) | 39.91% |
| Meridian HDR2 (Car) | 42.49% |
| Meridian HDR5 (Beach) | 32.29% |
| Sparks DirtLot | 34.57% |
| Sparks Welding | 25.18% |

#### Chimera HDR5



#### Meridian HDR2

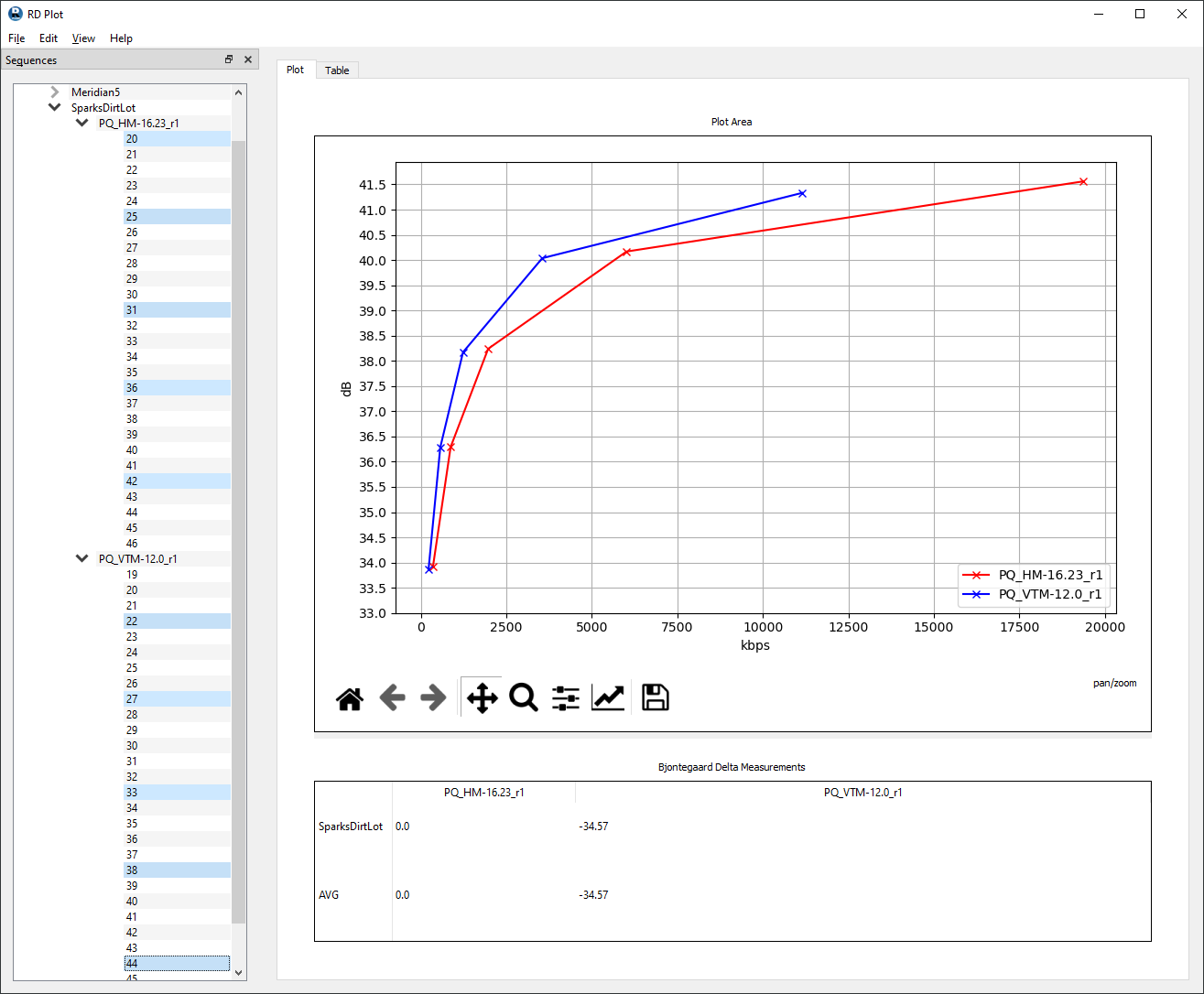
Chart

Description automatically generated

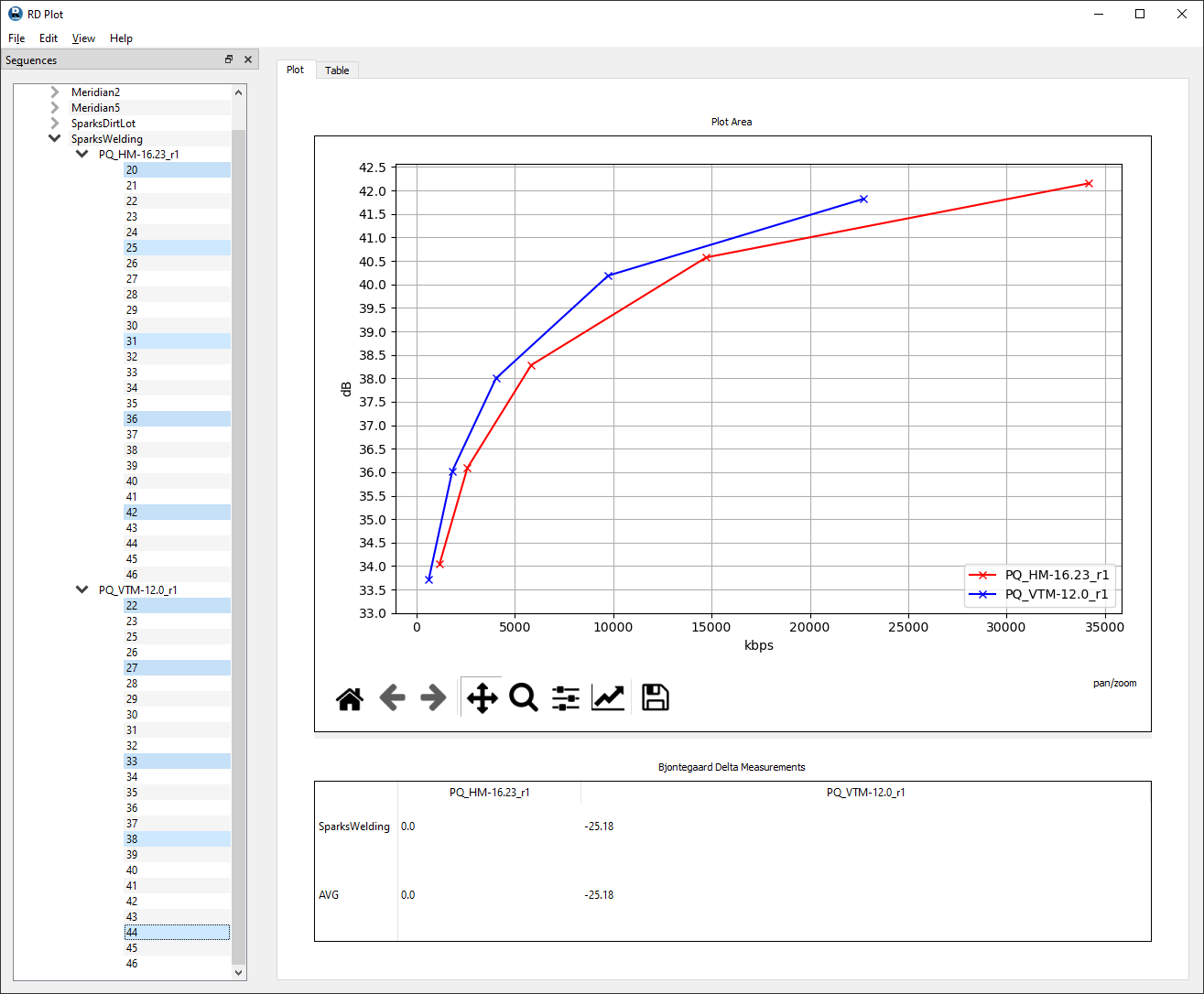
#### Meridian HDR5

# Graphical user interface, chart Description automatically generated

#### SparksDirtLot



#### SparksWelding



# References

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5. ETSI TS 101 154, *Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications*, 2019.
6. G. Bjøntegaard, “Calculation of average PSNR differences between RD-curves,” in ITU-T SG 16 Q.6 document VCEG-M33, 13th VCEG meeting, Austin, Texas, USA, Apr. 2001.
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