International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

# Report ITU-R BT.2381-0

(07/2015)

# Requirements for high dynamic range television (HDR-TV) systems

BT Series

Broadcasting service (television)


## Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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### Series of ITU-R Reports

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| **BO** | Satellite delivery |
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| **BS** | Broadcasting service (sound) |
| **BT** | **Broadcasting service (television)** |
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| **P** | Radiowave propagation |
| **RA** | Radio astronomy |
| **RS** | Remote sensing systems |
| **S** | Fixed-satellite service |
| **SA** | Space applications and meteorology |
| **SF** | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| **SM** | Spectrum management |

***Note**: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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REPORT ITU-R BT.2381-0

# Requirements for high dynamic range television (HDR-TV) systems

(2015)

## Overview

Future television systems should be capable of producing an experience that is either closer to real life or is capable of more accurately recreating the artistic intent of the storyteller. Increased resolution, wider colour palette, higher frame rate and an improvement in the dynamic range of the images when used together, have the potential to provide viewers with a better visual experience compared to current television applications and provide a viewer with a stronger sense of "being there".

A system that includes a greater image dynamic range, informed by Recommendation ITU-R BT.2020, has the potential to address some of the problems which current applications suffer due to their limited dynamic range including the loss of the detail, decrease in colour saturation, hue shift in highlight portion of images and the difficulty in reproducing differently illuminated portions in a scene.

Although a high dynamic range television (HDR-TV) system will share many common parameter values with current HD and UHD TV systems, as described in Recommendations ITU-R BT.709 and ITU-R BT.2020, an HDR-TV system should have no impact on the parameter values of these systems.

The first priority should be to specify an approach for an HDR-TV System that is designed specifically for completed television programme masters and the investigations into HDR-TV systems should only focus on the use in television broadcasting applications, including the international exchange of programmes.

If it is found to be necessary to develop other HDR-TV approaches for other television broadcasting applications, clear guidance must be given to identify the specific Application and Requirements that would apply in each case.

## Requirements

1. The system should be capable of producing a "step-change" improvement in viewer experience which can substantially increase brightness and detail in highlights, increase brightness and detail for diffuse reflecting[1] objects while providing good detail in dark areas.

The system should:

– produce a significant improvement in the perceived quality of the images when compared to current television applications;

– be used in a way that does not lead to adverse effects such as visual fatigue, or discomfort when viewed for a significant period of time[2].

2. The system should be optimized for use in television programme production and international programme exchange.

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[1] Diffuse Reflection is the reflection of light from a surface such that an incident ray is reflected at many angles rather than at just one angle as in the case of specular reflection.

[2] The effect of a greater image dynamic range on those affected by Photosensitive Epilepsy should be explored.

The system should:

– be optimized for completed television programme masters that are to be distributed after all programme production and post-production treatments[3] have been completed;

– consider the impact in contribution and emission bit rate reduction.

3. The system should have, where appropriate, a degree of compatibility with existing workflows and broadcaster legacy infrastructure[4].

The system should be capable of:

– the automatic conversion of an HDR TV master to a standard dynamic range (SDR) version;

– intermixing, spatially and temporally, HDR and SDR TV programming including graphics and video overlays, without introducing artefacts;

– use in live and non-live workflows;

– being monitored throughout the broadcast chain allowing for different viewing environments while providing consistent image reproduction at each point and allow straightforward monitoring of the waveform in relation to the perceived image brightness;

– a migration path from current SDR TV broadcasting to HDR TV broadcasting, taking into consideration:

  • that a gradual, non-disruptive introduction of HDR-TV into television broadcasting is desirable;

  • that HDR-TV should not require a marked increase in the use of metadata, beyond that currently required for television programme mastering, emission and international exchange;

  • that broadcasters prefer fully specified and documented technical solutions in broadcasting installations;

  • the need to maintain consistency between programme material and other interstitial material such as advertising and promotions;

  • the need to insert captions and other graphical services without affecting the visual acuity and accessibility requirements of such material.

4. The system should be applicable to a range of domestic viewing environments, preferences and displays (including mobile and tablets) and be cost effective for both consumers and broadcasters.

– The system specifications, including the brightness range, should not be limited by current technology constraints, but should be informed by relevant subjective studies of viewer preferences.

5. The system should have a defined reference display and viewing environment in order that there is consistency of images that are produced.

To facilitate this requirement the following should be developed and documented:

– the requirements and specifications of reference viewing environments;

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[3] It is recognized that, for example, it is possible that a different image dynamic range may be needed in programme capture, e.g. in order to provide greater headroom in post-production, but that choice depends on the decisions of the programme producer and of the programme director: it is not the purpose of any Recommendations to put forward an approach which might unduly overburden the production of programmes that do not require a large postproduction headroom**.**

[4] In this case “infrastructure” will include all processing and connectivity (SDI, Bit Rate Reduction, Switchers, Routers etc.).

– HDR reference signal(s) in order to facilitate consistency of the tone reproduction of programmes within a broadcaster's infrastructure, between broadcasters and between broadcast regions.

**Conclusions**

When an HDR television broadcast service is launched, the majority of television audiences will, initially, and for a period of several years, continue to watch programmes on consumer displays that are not capable of reproducing HDR images. It is essential therefore that broadcasters continue to deliver images in a manner such that programmes produced in HDR, when watched on non-HDR capable displays, will appear at least as good as, and certainly no worse than programmes produced and distributed in standard dynamic range (SDR).

In order to achieve some degree of image consistency across programmes produced for broadcasting, the home viewing environment as defined in Recommendation ITU-R BT.2022[5] should be taken into account.

A set of globally accepted reference parameters for HDR images should be clearly defined in order to minimise undesirable variations in HDR signals so that a stable environment may be established for television production and international exchange for HDR television signals[6].

[5] It is recognized that ITU-R BT2022 is titled General viewing conditions for subjective assessment of quality of SDTV and HDTV television pictures on flat panel displays and that further work may need to be carried out in order to include UHDTV and HDR requirements.

[6] It is also desirable that the work on colour conversion from Recommendations ITU-R BT.2020 to ITU-R BT.709 is completed. Without this work being completed down conversion is not possible on a consistent basis.