V2.0 OCT 2023

ASTROVA GUI DESIGN STANDARDS

PREVENTIVE MEASURES AGAINST IMAGE RETENTION

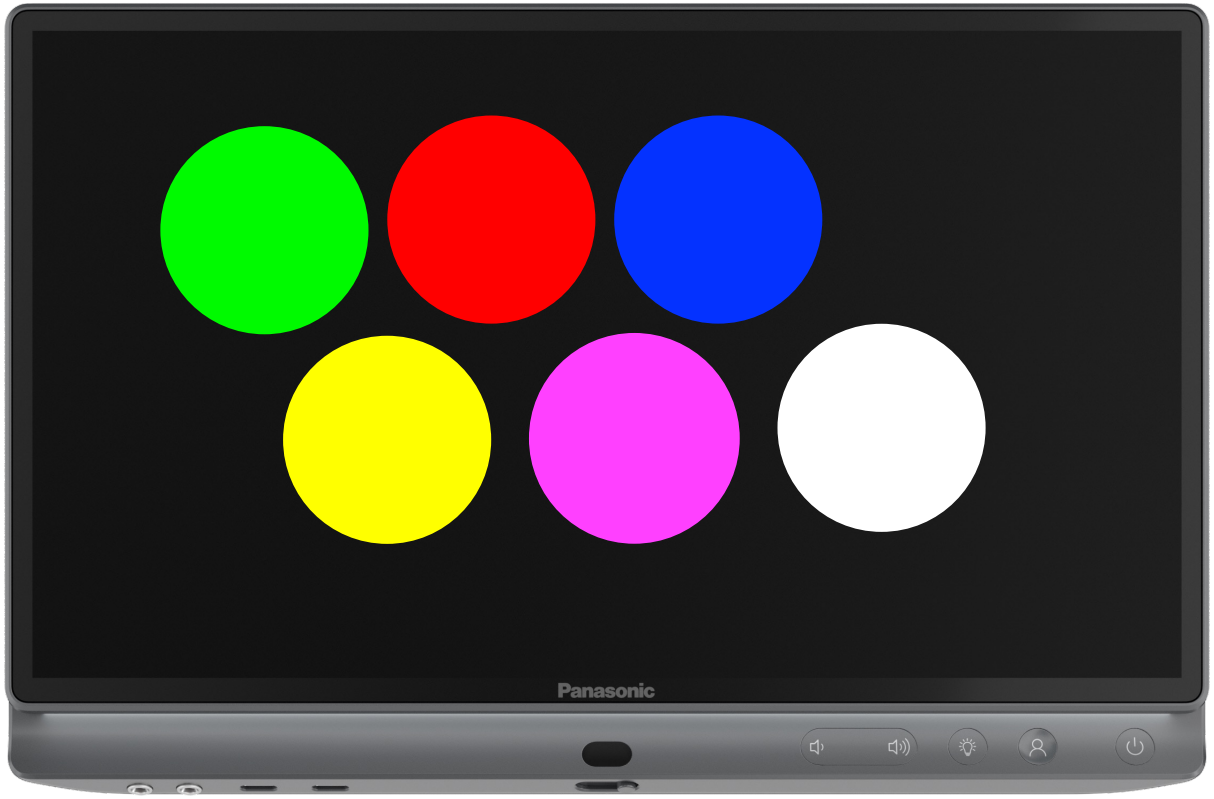
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PROBLEM DESCRIPTION

OLED monitors are subject to image retention over time under certain, abnormal usage conditions.

UI elements can be retained when they:

- appear in the same position on the screen for extended periods of time,
- have high color Saturation (R/G/B values),
- have high contrast with surrounding elements.



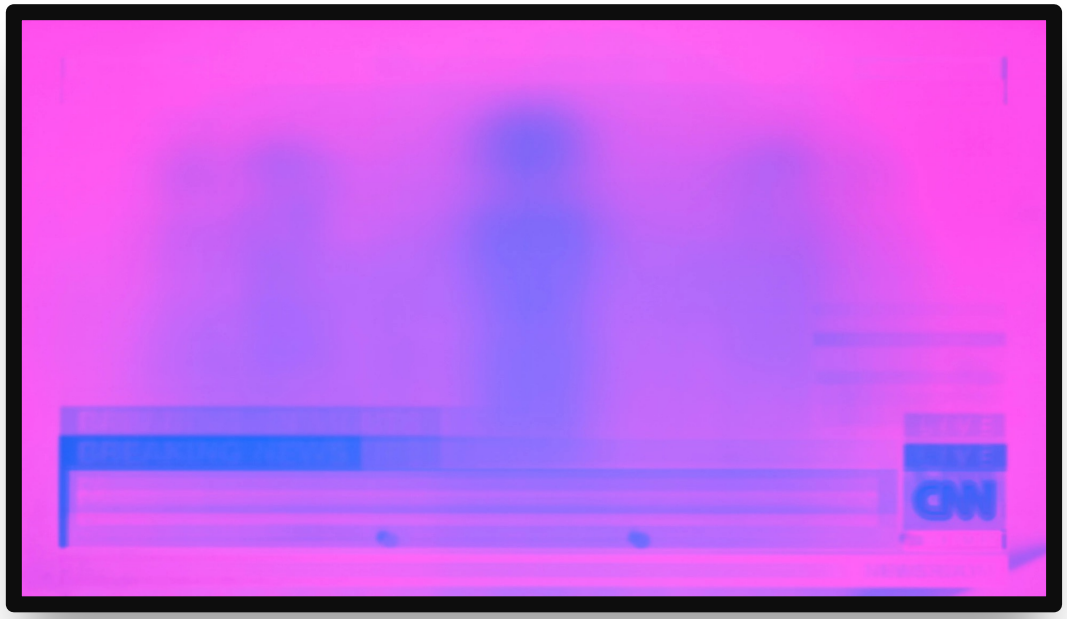
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OLED TV COMPARISON

OLED TV tests have shown image retention to occur with continuous play over many hours of channels that have persistent logos and graphics (e.g., news and sports stations).

TV Manufacturers have implemented a number of mitigation features including:

- Pixel shift*
- Screen saver
- Automatic logo dimming*
- Pixel refresh*



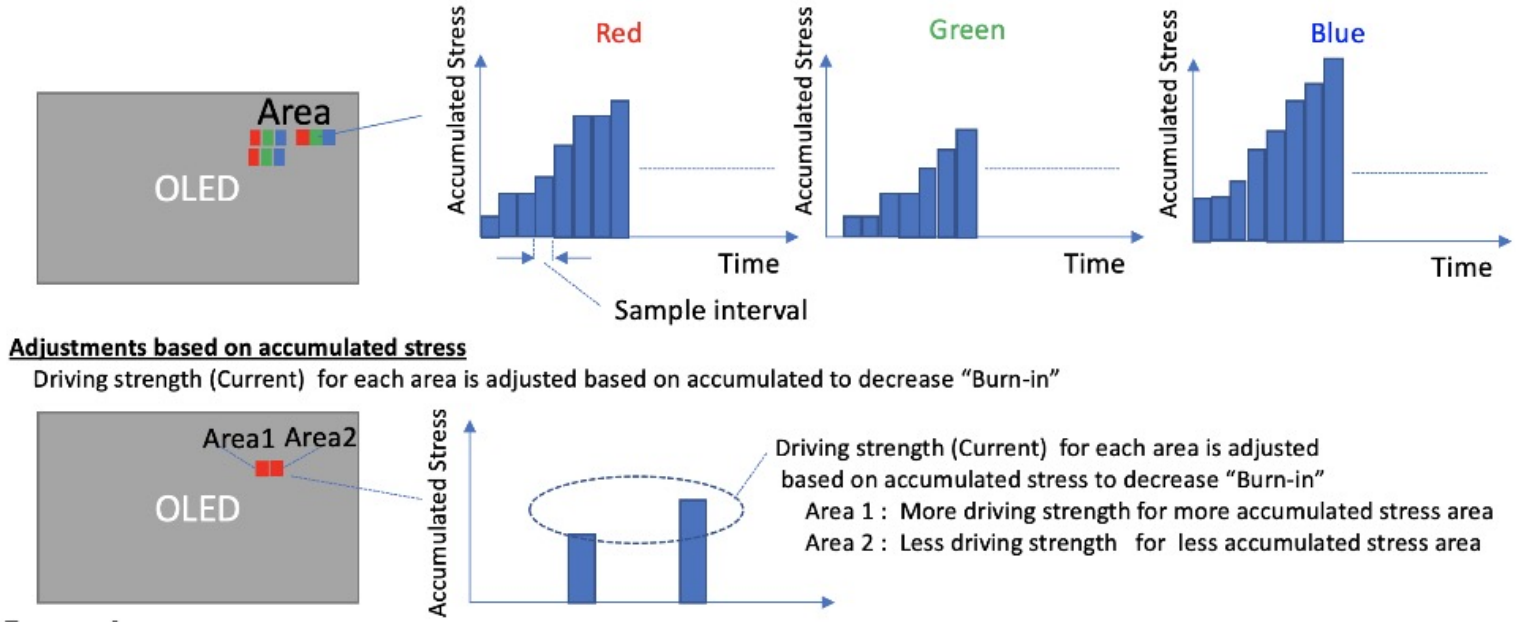
* For more on these, see: “Here’s Why You Can Stop Worrying About OLED Burn-in”
https://reviewed.usatoday.com/televisions/features/most-oleds-have-built-measures-prevent-burn

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ASTROVA HARDWARE ALGORITHM

The Astrova hardware has a **built-in algorithm** to protect against image retention. This algorithm adjusts the driving strength (current) for each area based on the accumulated stress for that area.

Areas in which more pixel wear has occurred are driven with less current.



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OLED GUI DESIGN STANDARDS

In addition to hardware protection, implementing certain principles in the GUI design can further reduce the risk of image retention over time. Each of these principles also corresponds to better passenger experience design in addition to screen protection.

The following GUI design principles are prescribed as standards for Astrova:

REQUIRED

a) Turn off the screen after 5m of inactivity in the air.

b) Use an “active screensaver” on the ground if keeping the screen on for longer than 10m

c) Vary map elements in auto-play.

RECOMMENDED

d) Minimize static UI elements.

e) Use darker backgrounds.

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[A] SCREEN OFF TIMER IN AIR.

The best preventive measure for image retention is the **screen-off / inactivity timer**.

For OLED, the prescribed screen-off timer value is **5m**.

(Note: All of our prior systems have enforced inactivity timers, this concept is not new to Astrova.)

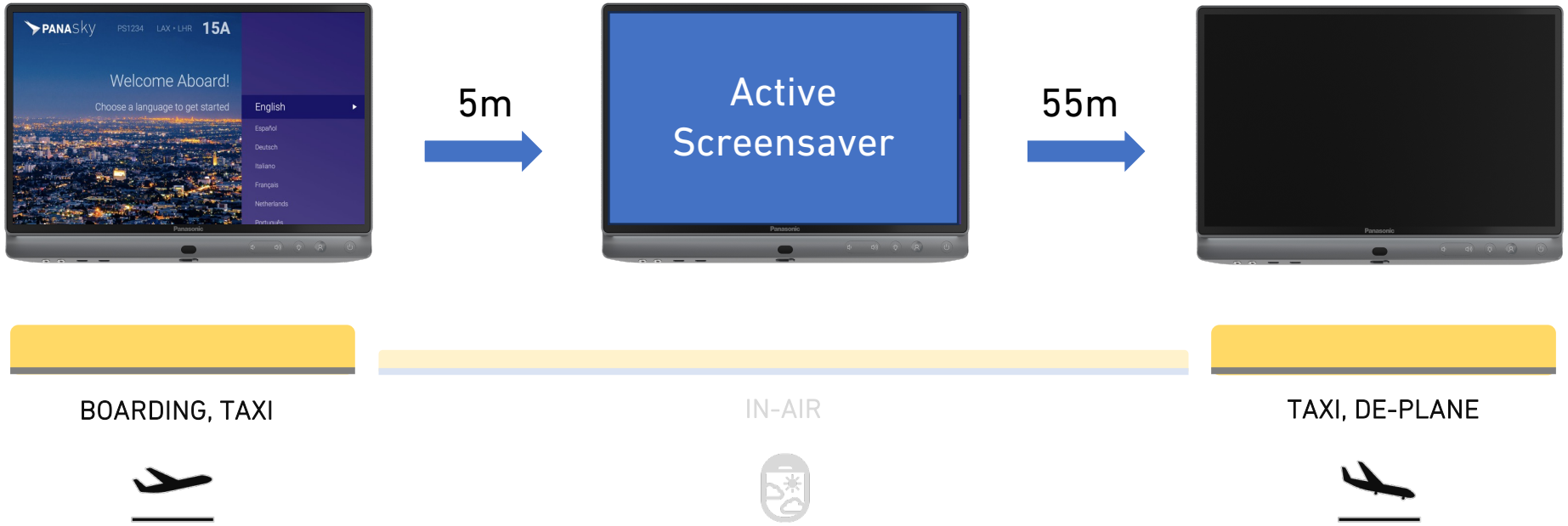


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[B] ACTIVE SCREENSAVER ON GROUND.

On the ground, many of our customers prefer to have longer timeouts configured so the passengers are greeted with brightly lit screens.

If an extended screen timeout is configured on the ground, then the interactive should transition to an **active screensaver** mode after 5m of inactivity to protect against image retention.



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[B] ACTIVE SCREENSAVER ON GROUND

ACTIVE SCREENSAVER TYPES

Active screensaver may be a **looping video, slideshow or animated UI**.

The nature and type of active screensaver used is left to the program design team. The content of the video or slideshow must be **highly variable** (dynamic).

(It must not have high contrast logos or information shown consistently in the same place.)

PAC Design & Experience group must review the screensaver sequence for OLED-readiness.

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[B] ACTIVE SCREENSAVER ON GROUND

ACTIVE SCREENSAVER

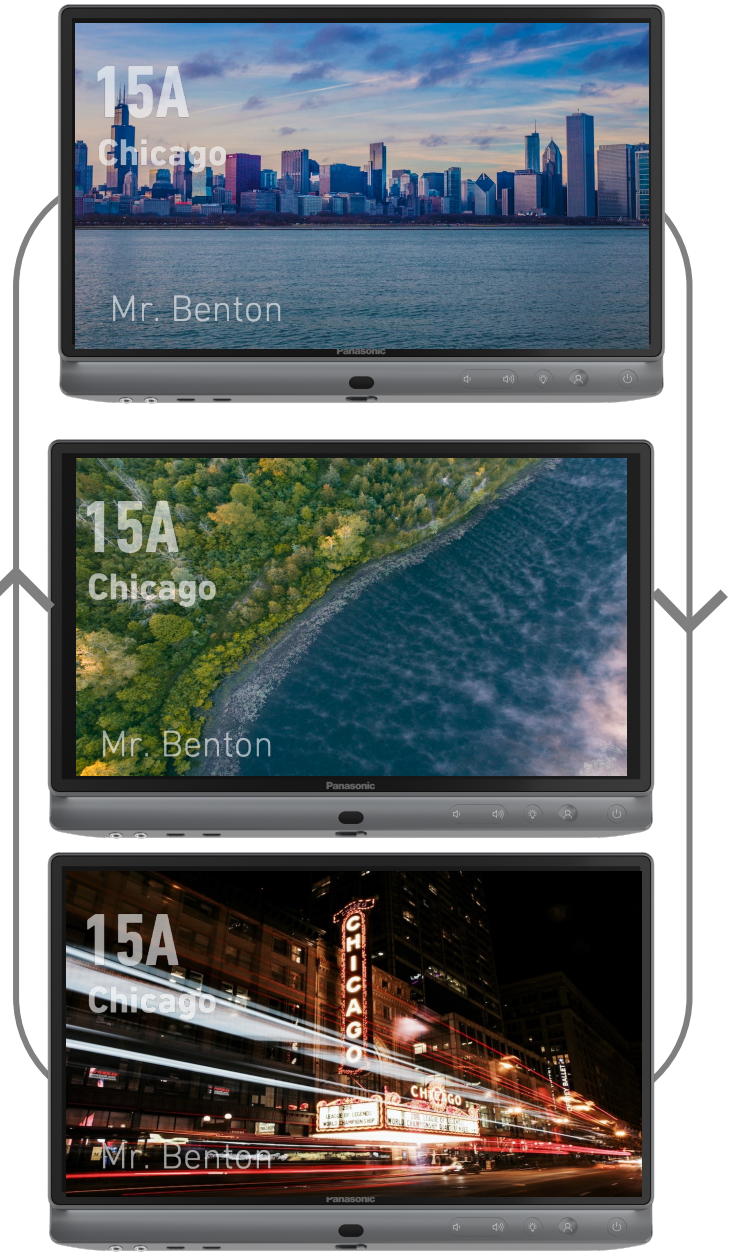
On Ground (Entertainment On)



After 10m idle

User touches screen

Active Screen Saver Loop



This illustrates the active screensaver during the boarding process. Pictured above is the the in-use state. After an idle timeout, the screensaver loop to the right is activated. When the user touches the screen the screensaver is deactivated and returns to the normal welcome screen.

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[B] ACTIVE SCREENSAVER ON GROUND

SCREENSAVER OVERLAY

If the active screensaver incorporates any static seat, flight or personal information, the overlayed information must be displayed in low contrast/muted colors.

Recommendation is to show the seat number and any other static overlays with transparency (e.g., white 60% opacity).





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[C] VARY AUTOPLAY ELEMENTS

During Autoplay, the map should **vary the location** of elements on the screen. A text or UI element should not appear in the same location on each slide or screen.

In the case of map user controls, the controls can be hidden when the screen is not touched for a certain amount of time, and then re-displayed when the user touches the screen.







DO

Vary the location of visual elements between slides

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[C] VARY AUTOPLAY ELEMENTS

During Autoplay, the map should **vary the location** of elements on the screen. A text or UI element should not appear in the same location on each slide.

In the case of map user controls, the controls can be hidden when the screen is not touched for a certain amount of time, and then re-displayed when the user touches the screen.



DON'T

Have the same element on each slide. This control could be hidden until the user touches the screen.

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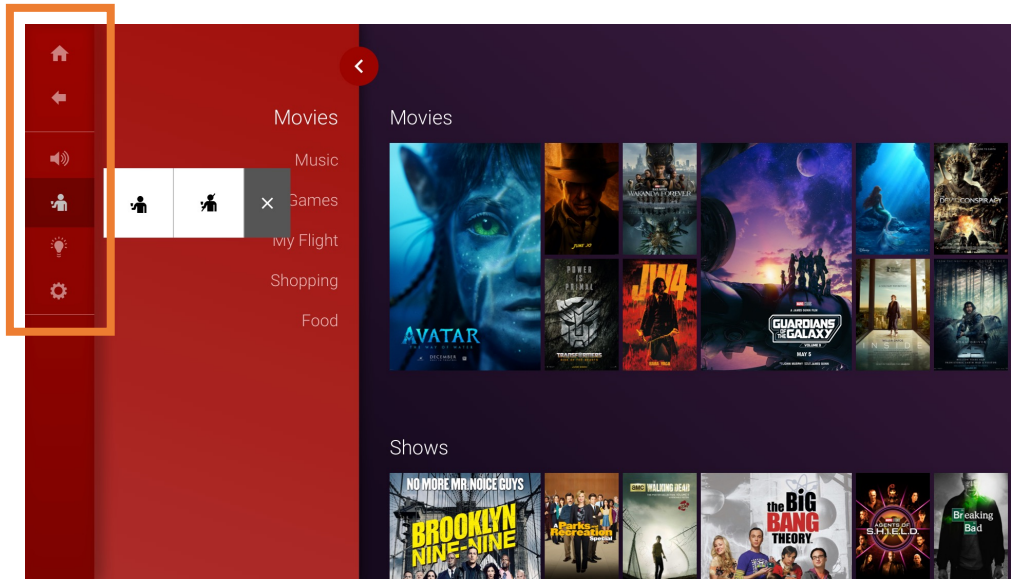
[D] MINIMIZE STATIC UI ELEMENTS

Static UI Elements appear throughout the GUI in the same place.

Minimize the number of static elements throughout the GUI.

For global controls such as navigation and PSS icons, consider having them either **fade in contrast or slide away** after a few seconds of inactivity.

Where static elements are required, **lower the contrast** to minimize risk.



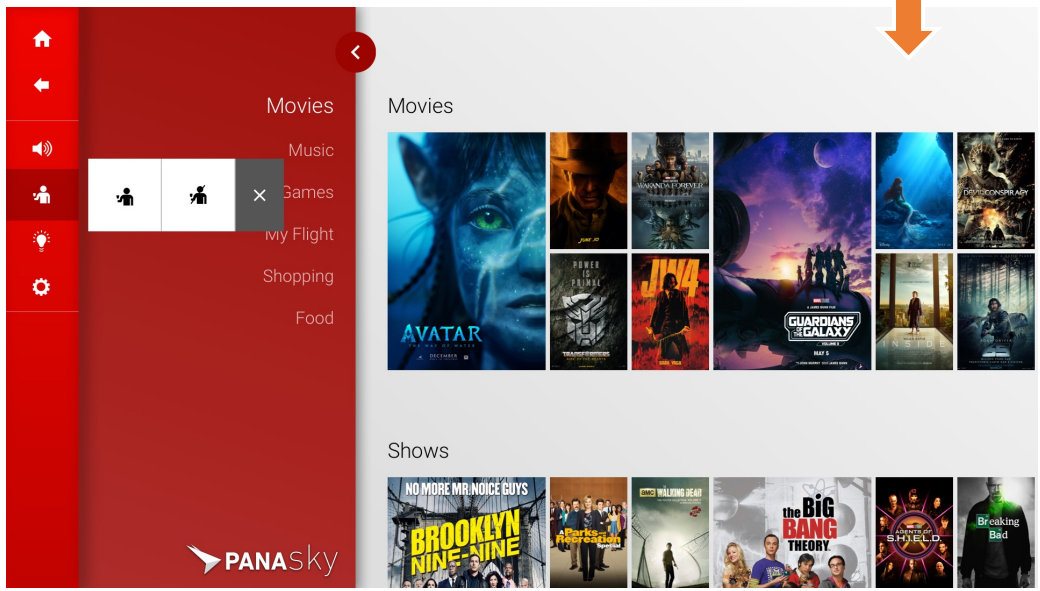
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[E] USE DARKER BACKGROUNDS.

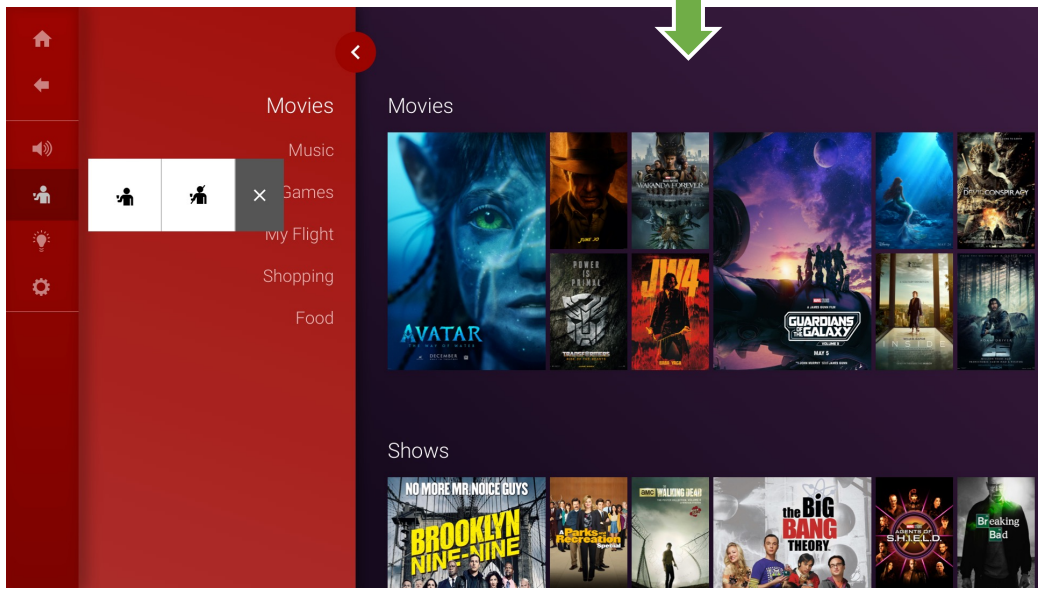
Dark backgrounds are friendlier to the longevity of any monitor, including OLED.

As such a dark background is recommended, but not a requirement.

Light BG



Better



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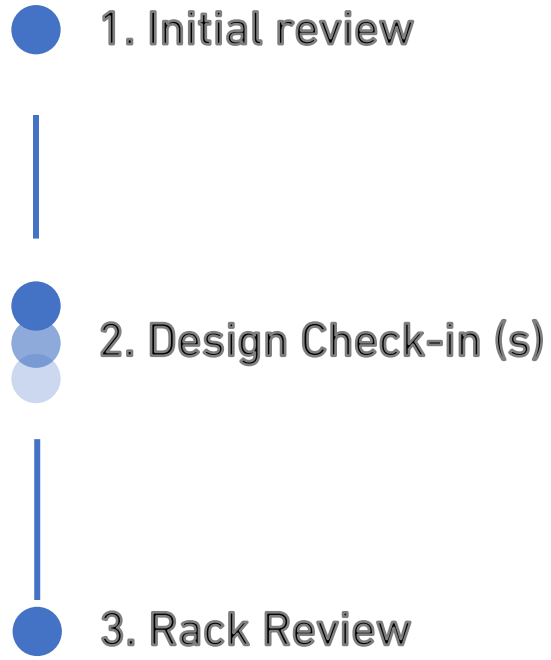
AUDIT PROCESS

AUDIT/REVIEW PROCESS

PAC internal user experience group (D&E) will regularly review/audit the interactive (+ relevant apps) and provide feedback for OLED-readiness.

Expert review process helps to increase quality across the holistic passenger experience.

1. **Initial review** – when *initial design drops* are provided in InVision.
2. **Design check-in(s)** – when *significant updates* occur or the design is nearing customer approval for *handover to implementation*.
3. **Rack Review** – when *loaded to rack*, make sure that all dynamic measures have been implemented correctly.



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