

Assertive Display[®]

www.apical.co.uk

*You can't watch a movie by the pool...
...can you?*



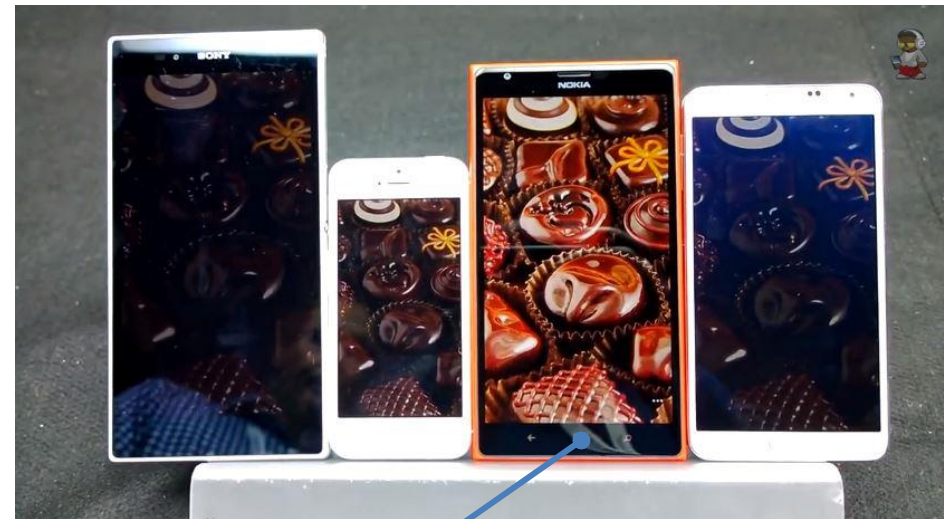
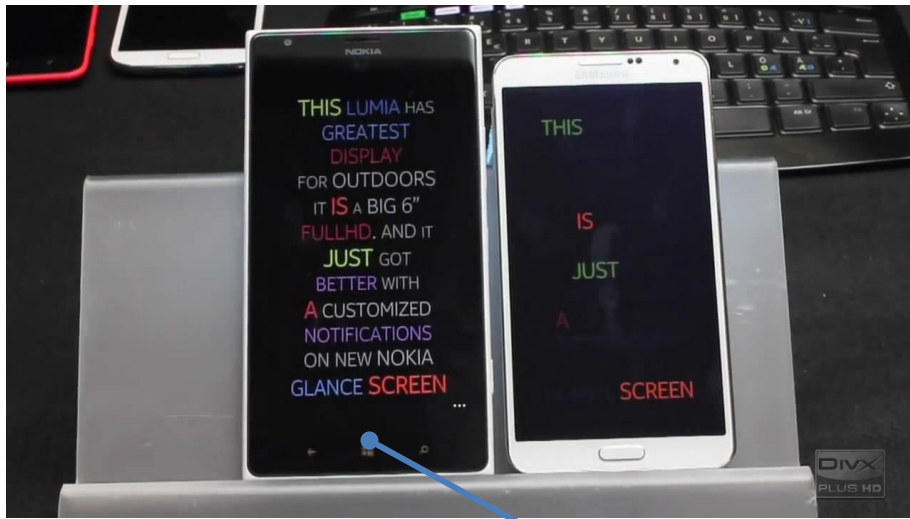
Amazon Kindle "Poolside" commercial Fall 2010

Apical has spent 10 years learning how to model the human visual system and create devices which “see like the eye” and has proven its core technologies in over half a billion devices

We intend to create the most natural user experience

- **Feeling**
- **Emotion**
- **Enquiry**
- **Understanding**





Lumia 1520
with Assertive Display



What is Apical's Assertive Display?

Assertive Display is a display management subsystem which addresses the two most important problems for mobile displays:

Display power can be reduced by up to 50%

Multimedia can be viewed even in bright sunlight

Assertive Display operates with all current screen technologies, and can be calibrated to the specific screen response characteristics

Watch a movie in any conditions



Assertive Display:
Content adapted to display contrast ratio
Same power consumption



Display at max brightness:
contrast ratio too low for multimedia

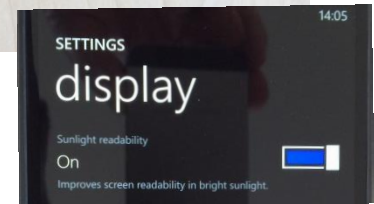
Sample conditions: Ambient light 1400 lux –indoors in daylight

HALO 4 on the Lumia 1520

Assertive Display Off



Assertive Display ON





Assertive Display:
Content adapted to display contrast ratio
Same power consumption



Normal display:
Display at max brightness:
contrast ratio too low for multimedia

Sample conditions: Ambient light 1400 lux –indoors in daylight



Assertive Display ON
(No specific calibration)



Assertive Display OFF

Ambient light 200 lux. Smartphone: full brightness. TV: Standard Mode



Convention

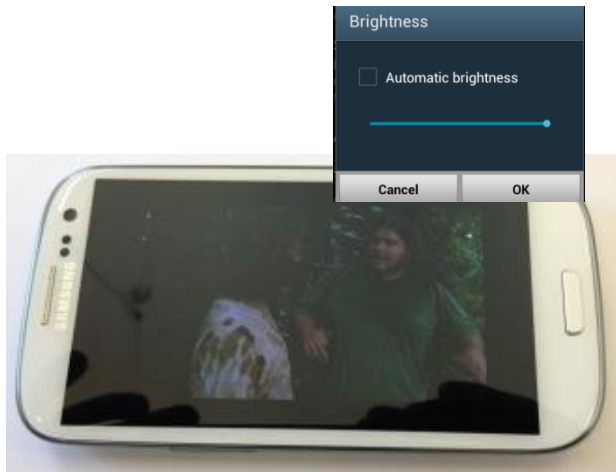
May not be able to see preview at all under sunlight

Assertive Display

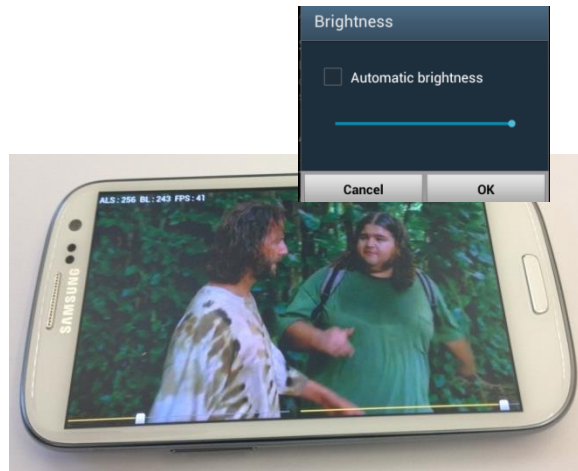
Calibrated, accurate preview of how image will appear on high quality display at home



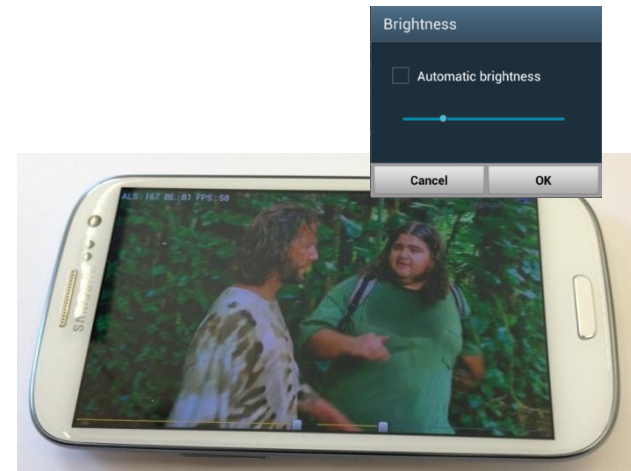
Assertive Display combines power saving and much better multimedia viewability



No Assertive Display:
100% screen brightness



Assertive Display:
100% screen brightness

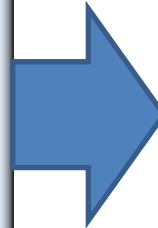


Assertive Display:
25% screen brightness

Why is Assertive Display effective?

The key to Assertive Display is:

- It enables independent adjustment of bright and dark regions of each frame
- So it **decouples brightness from contrast ratio**



Brightness can be set according to preference and power saving

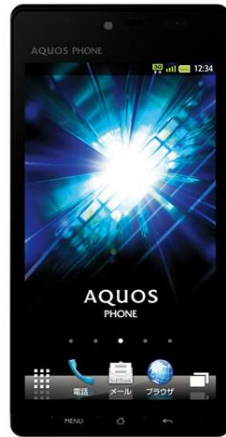
Contrast ratio is **always correct** for optimal multimedia viewability



Early adopters Shipping products (announced)



Pantech Vega
2D LCD



Sharp Aquos
2D/3D LCD



Kyocera Urbano
OLED




Huawei Ascend D2
LCD



Nokia Lumia 1520
LCD

e.g.



 Eco backlight control is using the Assertive Display technology Apical Limited.

Quality meets requirements of high-end HDTVs: B&O Beoplay V1:

ADAPTIVE CONTRAST
THE TV THAT WATCHES YOU!

The human eye has an amazing ability to adapt to different light conditions. We've been inspired by that ability and have built it into Beoplay V1. There's a huge difference between watching the news in the middle of the day with bright light shining through the windows, and watching your favorite movie at night with

the TV as the main source of light in the room. The Beoplay V1 adaptive contrast uses a built-in light sensor and an advanced piece of software that will adjust not only the brightness, but the colours and image quality of your TV according to the surrounding light. In this way your eyes will not get tired of watching.



<http://www.beoplay.com/Products/BeoplayV1#adaptive-contrast>



*From 2013, Assertive Display
is available to Qualcomm users*



Qualcomm Snapdragon 800



Smartphones



Tablets

Full hardware solution operating at low power and active for all display content

Product example

Sharp handsets: 50% display power saving

SoftBank 104SH



AQUOS PHONE

SoftBank 104SH

1.5GHz dual core

"Eco Tech" feature

Power saving and backlight control and image processing technology for high picture quality will always keep, by suppressing power consumption automatically when you start multiple applications at the unexpected, you can extend the battery has.

"Eco Tech" function

About 50% of backlight power consumption by up to ※ 1 reduction, about 40% more power waiting受時 ("waza-ari" mode) ※ two energy savings may be reduced.

※ 1 The provisional value.



※ 2 Numerical technique eco "normal" mode and "waza-ari" is compared with the provisional mode. Your environment by energy savings may vary.



省電力

Power saving feature

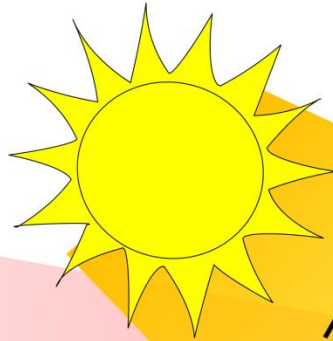
Save battery life easily by pressing one button.

 Full Widescreen HD 4.5 inch	 En Jpn / Eng	 Global Roaming	 12.1M pixel
 GPS	 Bluetooth®	 micro SDHC™	 IrDA
 Android 4.0	 Wi-Fi	 Waterproof	 Osaiifu Keitai



Eco backlight control is using the Assertive Display technology Apical Limited.

The challenge of the mobile viewing environment



screen reflections

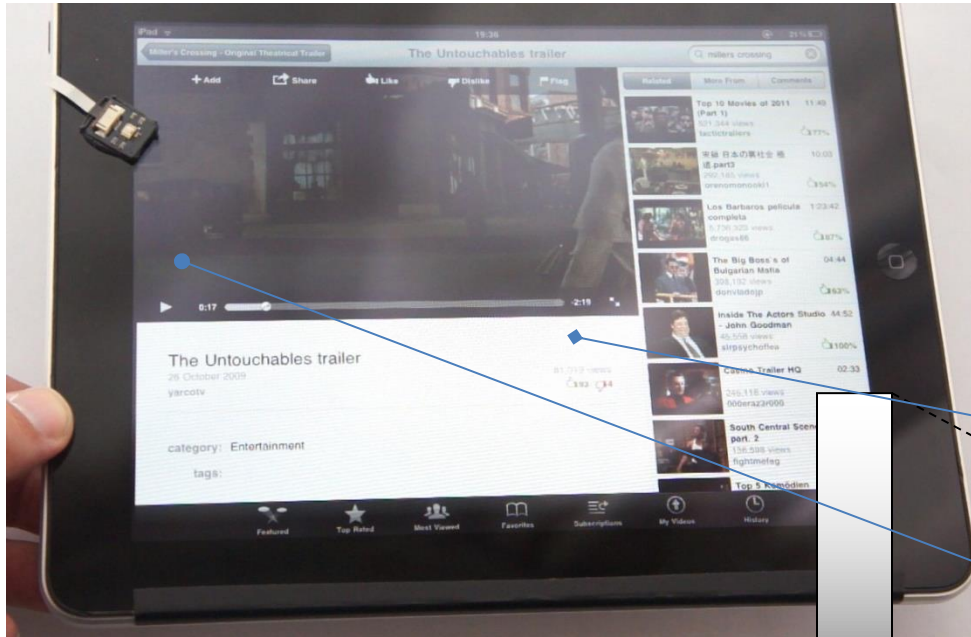
screen emissions



Difficult for emissive display to compete with sun's brightness!

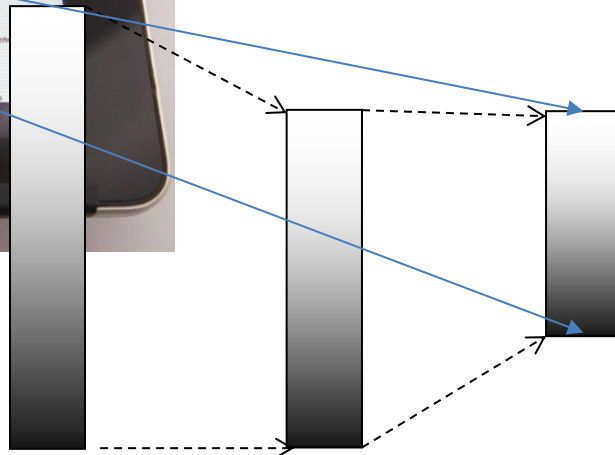
Often need to reduce display brightness to conserve power

Problem statement



Display contrast ratio is affected **independently** from the bright and dark ends of the range

Display contrast ratio must be **adapted independently**



Full
brightness
Dark room

Reduced
brightness
Dark room

Reduced
brightness
Bright room

Display contrast ratio changes from 45,000:1 to 50:1 with ambient light

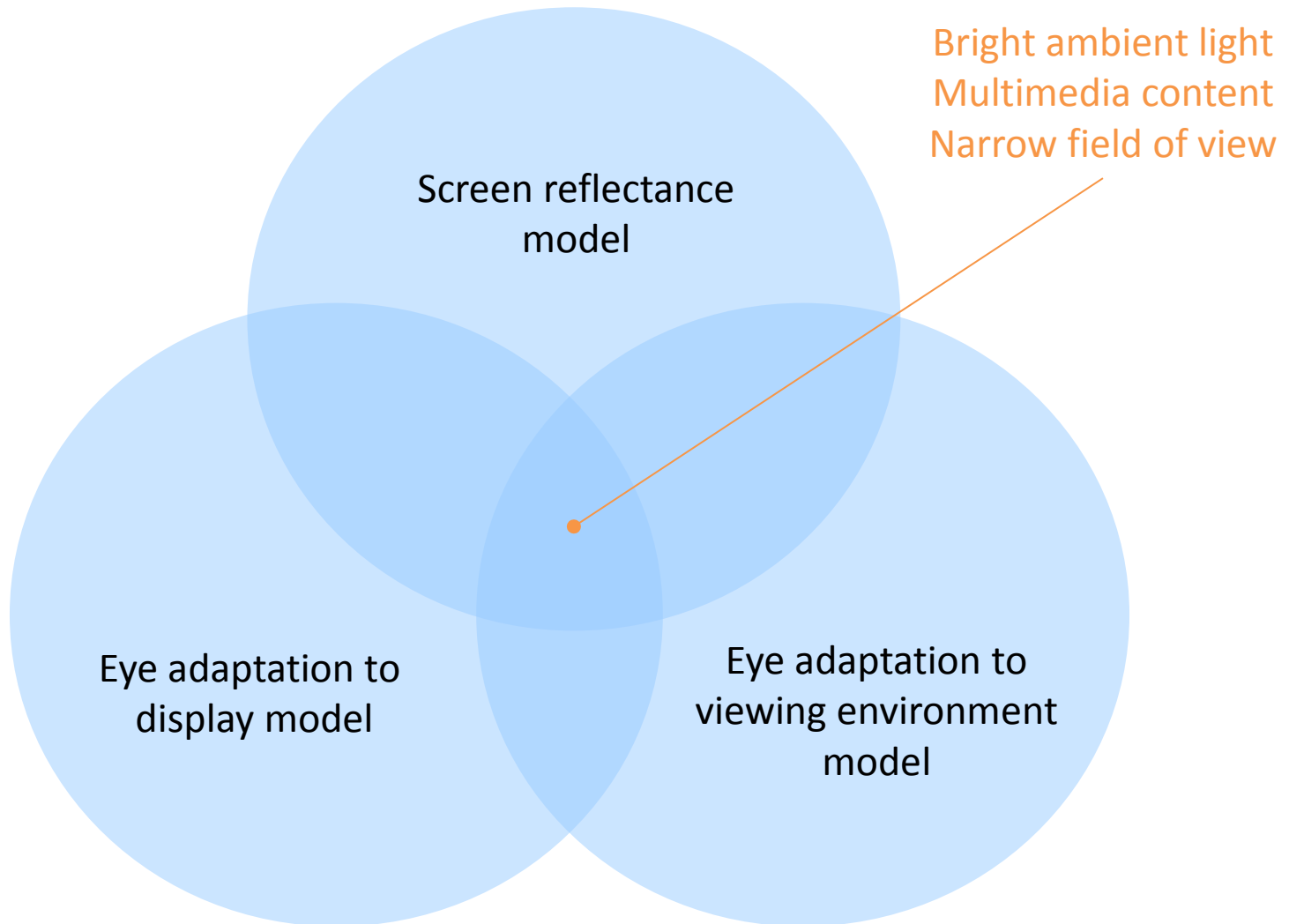


Measured Maximum Brightness 100% Full Screen White	Brightness 541 cd/m ² Excellent	Brightness 556 cd/m ² Excellent	Brightness 224 cd/m ² Poor	Maximum Brightness is very important for mobile because of the typically high ambient light levels.
Measured Peak Brightness 1% Full Screen White	Brightness 541 cd/m ² Excellent	Brightness 556 cd/m ² Excellent	Brightness 283 cd/m ² Good	This is the Brightness for a screen that has only a tiny 1% Average Picture Level.
Black Level at Maximum Brightness	Black is 0.48 cd/m ² Very Good for Mobile	Black is 0.41 cd/m ² Very Good for Mobile	Less than 0.005 cd/m ² Outstanding	Black brightness is important for low ambient light, which is seldom the case for mobile devices.
Contrast Ratio Relevant for Low Ambient Light	1,117 Very Good for Mobile	1,356 Very Good for Mobile	Greater than 45,000 Outstanding	Only relevant for low ambient light, which is seldom the case for mobile devices. Defined as Maximum Brightness / Black Brightness.
Contrast Rating for High Ambient Light	Bright Contrast 77 Very Good	Bright Contrast 121 Excellent	Bright Contrast 45 - 57 Good	Defined as Maximum Brightness / Average Reflectance.
Screen Readability in Bright Light	Very Good A-	Excellent A	Good B	Indicates how easy it is to read the screen under high ambient lighting. Very Important! See High Ambient Light Screen Shots
	iPhone 4	iPhone 5	Galaxy S III	

Source: http://www.displaymate.com/Smartphone_ShootOut_2.htm

Contrast ratio for High Ambient Light measured at 40,000 lux

Assertive Display combines 3 interacting analytical models

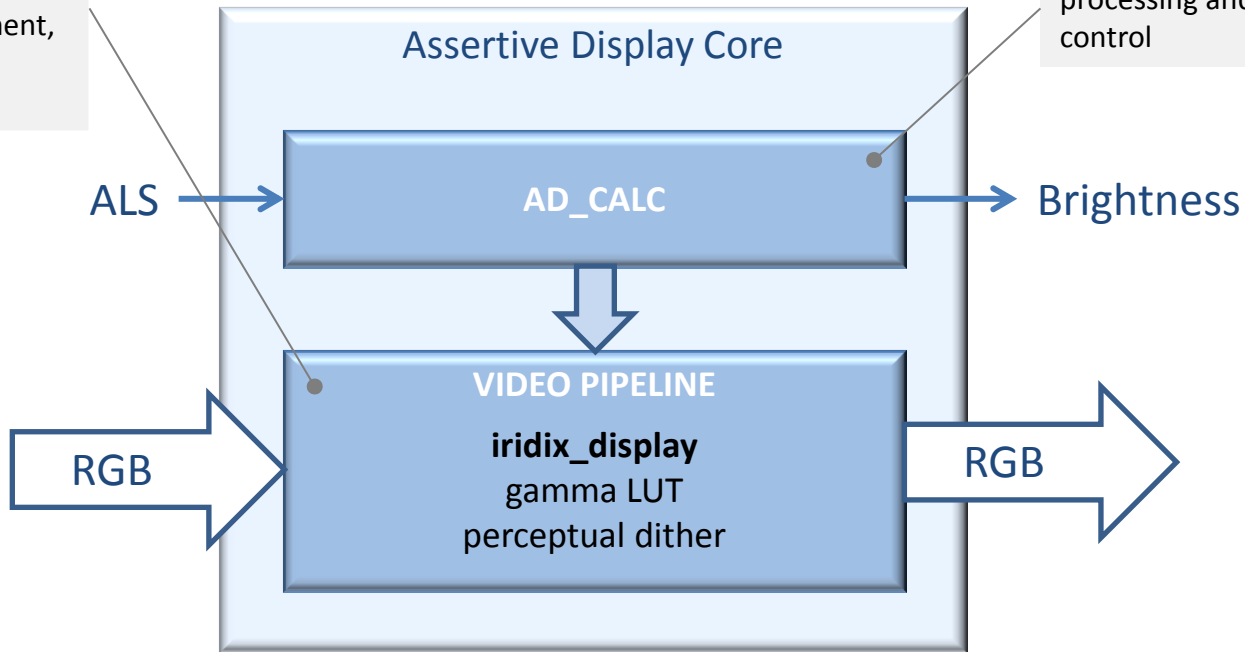


Assertive Display core IP is associated with 6 separate patents



3 patents covering local tone mapping, local contrast management, local color management

3 patents covering ALS processing and display control

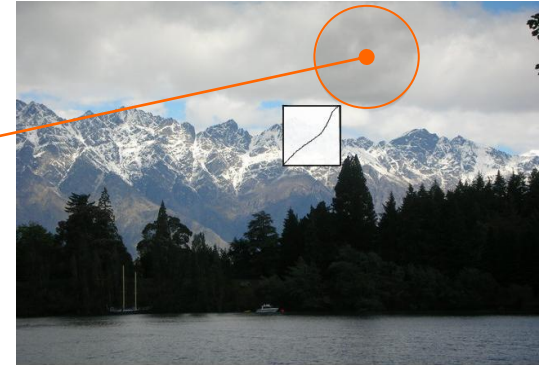


Video processing engine: Pixel-by-pixel tone mapping



iridix calculates a unique tone curve for each pixel of each frame

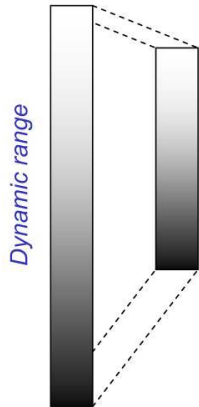
Contrast in highlights
enhanced



Contrast in midtones
preserved

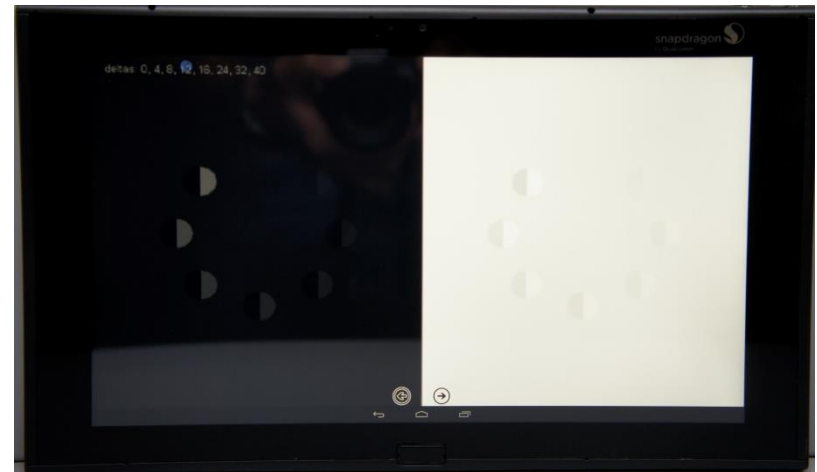


Contrast in shadows
enhanced





- Assertive Display contains calibration registers which should be tuned for the specific display type (not per-unit)
- Apical provides an Calibration App which enables direct calibration on the device
- Calibration results are stored and loaded by driver at device bootup
- Apical supports OEMs via on-site calibration to target devices and training
- Once calibrated, Assertive Display works automatically without end user intervention



Assertive Display Calibration App for Android on Liquid