Implementing Night Light

Research suggests that blue light from screens can have a negative impact on sleep. Android 7.1.1 includes a feature called Night Light that reduces the amount of blue light emitted by the device display to better match the natural light of the user's time of day and location. Android 8.0 includes a feature that gives users more control over the intensity of the Night Light effect.

Night Light requires a <u>Hardware Composer HAL 2.0</u> (https://source.android.com/devices/graphics/implement-hwc.html) (HWC 2) implementation that can apply the matrix passed to `setColorTransform` to perform tinting without impacting power, performance, and app compatibility.

Implementation

Device manufacturers can enable the default implementation of the feature by using the following flags defined in: <u>**/android/frameworks /base/core/res/res/values/config.xml**</u> (https://android.googlesource.com/platform/frameworks/base/+/master/core/res/res/values/config.xml)

```
<!-- Control whether Night display is available. This should only be enabled
     on devices with HWC 2 color transform  support. -->
 <bool name="config_nightDisplayAvailable">false</bool>
 <!-- Default mode to control how Night display is automatically activated.
      One of the following values (see NightDisplayController.java):
          0 - AUTO_MODE_DISABLED
          1 - AUTO_MODE_CUSTOM
          2 - AUTO_MODE_TWILIGHT
 -->
 <integer name="config_defaultNightDisplayAutoMode">0</integer>
 <!-- Default time when Night display is automatically activated.
      Represented as milliseconds from midnight (e.g. 79200000 == 10pm). -->
 <integer name="config_defaultNightDisplayCustomStartTime">79200000</integer>
 <!-- Default time when Night display is automatically deactivated.
      Represented as milliseconds from midnight (e.g. 21600000 == 6am). -->
 <integer name="config_defaultNightDisplayCustomEndTime">21600000</integer>

 <!-- Minimum color temperature, in Kelvin, supported by Night display. -->
 <integer name="config_nightDisplayColorTemperatureMin">2596</integer>
 <!-- Default color temperature, in Kelvin, to tint the screen when Night display is
      activated. -->
 <integer name="config_nightDisplayColorTemperatureDefault">2850</integer>
 <!-- Maximum color temperature, in Kelvin, supported by Night display. -->
 <integer name="config_nightDisplayColorTemperatureMax">4082</integer>
```

The code is divided between framework, system services, SystemUI, and Settings:

```
platform/frameworks/base/core
├ java/android/provider/Settings.java
├ java/com/android/internal/app/NightDisplayController.java
└ res/res/values/config.xml

platform/frameworks/base/proto/src/metrics_constants.proto

platform/frameworks/base/services
├ core/java/com/android/server/display/DisplayManagerService.java
├ core/java/com/android/server/display/DisplayTransformManager.java
├ core/java/com/android/server/display/NightDisplayService.java
└ java/com/android/server/SystemServer.java

platform/frameworks/base/packages/SystemUI
├ res/drawable/ic_qs_night_display_off.xml
├ res/drawable/ic_qs_night_display_on.xml
├ res/values/strings.xml
└ src/com/android/systemui/qs/tiles/NightDisplayTile.java

platform/packages/apps/Settings
├ AndroidManifest.xml
├ res/drawable/ic_settings_night_display.xml
├ res/values/strings.xml
```

```
├ res/xml/display_settings.xml
├ res/xml/night_display_settings.xml
├ src/com/android/settings/Settings.java
├ src/com/android/settings/dashboard/conditional/NightDisplayCondition.java
├ src/com/android/settings/display/NightDisplayPreference.java
├ src/com/android/settings/display/NightDisplayPreferenceController.java
└ src/com/android/settings/display/NightDisplaySettings.java
```

UI features

Because Night Light is a user-facing feature, users need to be able to control it. There is a full implementation of the settings in the Android Open Source Project (AOSP) packages/apps/Settings (https://android.googlesource.com/platform/packages/apps/Settings/) project that device manufacturers can reference for their Settings implementation. Implementers must handle the `Settings.ACTION_NIGHT_DISPLAY_SETTINGS` (https://developer.android.com/reference/android/provider/Settings.html#ACTION_NIGHT_DISPLAY_SETTINGS) intent to expose this setting.

Settings

The settings for Night Light are in *Settings > Display > Night Light*. From there, users can learn about Night Light, set its schedule, and turn it on or off.

- **Turn On Automatically**
  - **Never**: Night Light will never turn on automatically and must be activated with the manual **On / Off** toggle.
  - **Custom schedule**: Night Light turns on at a specified **Start time** [default: 10:30 p.m.] and off at a specified **End time** [default: 6:30 a.m.].
  - **Sunset to sunrise**: Night Light turns on at sunset and off at sunrise. The time for sunrise and sunset depends on the device location and the time of year.
- **On / Off**: Toggle that controls the current state of Night Light. This state respects existing automatic rules. For example, if Night Light is toggled on at 5:30 p.m. (before the automatic rule would turn it on at 10:30 p.m.), Night Light will still turn off at 6:30 a.m. And if Night Light is toggled off at 5:30 a.m. (before it turns off at 6:30 a.m.), it will still turn on at 10:30 p.m.
- **Intensity**: Seekbar (https://developer.android.com/reference/android/widget/SeekBar.html) that controls the tint level by sliding from warm to cool. The seekbar can be disabled when Night Light is not activated.
- **Informational text**: Teaches the user what Night Light does and why.

Settings conditional

Visible at the top of Settings when Night Light is on.

Quick Settings tile

The Quick Settings tile behaves identically to the **On / Off** toggle in *Settings > Display > Night Light*.

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