# Sample Messaging Document – Qualcomm

## QMT High Level Messaging – Mirasol Displays

Qualcomm Mirasol displays are designed to enable top performance in display-based power efficiency and screen visibility. Because of their radically unique approach to color selection and their use of reflected light, devices with Mirasol displays, from wearables to smartphones, will deliver superior experiences defined by days of always on, always useful battery life.

Mirasol display-enabled products directly respond to emerging mobile trends where content is served in a quiet, almost passive but always useful, manner. The next-generation Mirasol displays, based on the SMI (Single Mirror IMOD) architecture, add on to this experience with dramatically enhanced visual performance characteristics.

To best accelerate penetration into the wearable device category, device manufacturers can leverage the Qualcomm Toq wearable reference design platform. Toq reference designs offer a cost-effective and accelerated path, centered around Qualcomm Mirasol displays, to enter the wearable device category in a highly optimized and differentiated way.

## QMT - Mirasol Message Points

1. **Qualcomm Mirasol displays are the ideal display solution for the wearable device segment.**

   **Low Power Profile**

   **Qualcomm Mirasol displays are low power enough to enable always on, always-useful mobile experiences, ideally suited to the wearable device category.**

   a. Mirasol displays consume only a small fraction of the power compared to LCD and OLED wearable device displays.
      - Mirasol displays consume **less than .20 mA** of current in a typical wearable display model (.18 mA average in today's technology, .11 mA in SMI).
      - For today's Mirasol display technology, this equates to a **31X power advantage vs. OLED** and a **130X advantage over LCD**-based display configurations.

- SMI-based Mirasol displays are even more efficient and boast a **52X advantage vs. OLED** and **218X advantage over LCD**-based wearable device configurations.
- See Table Below

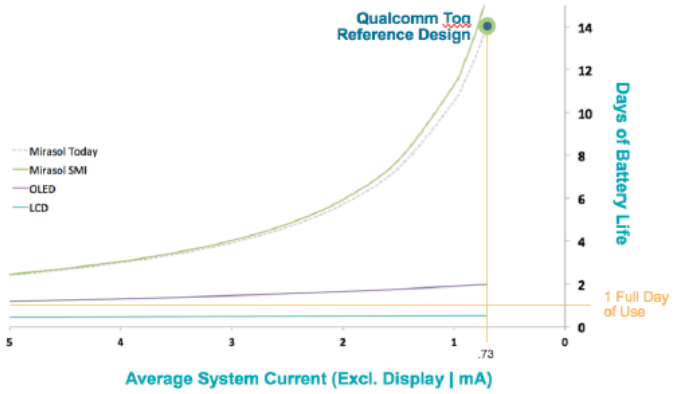
| Usage | Mirasol | OLED | LCD |
|---|---|---|---|
| Always On [1] | 0.07 mA | 5.41 mA | 23.24 mA |
| Interactive | 1.36 mA | 12.16 mA | 31.08 mA |
| Average (SMI / Today) | 0.11 / 0.18 mA | 5.62 mA | 23.49 mA |
| | Mirasol Advantage Today | 31X | 130X |
| | Mirasol Advantage (SMI) | 52X | 218X |

[1] OLED and LCD at reduced brightness and/or reduced lit pixels in Always On mode

Note: data measured in Qualcomm labs from 1.5-1.6" Mirasol, OLED and LCD displays. Average figure is a mix of 23 hours of Always on and one hour of Interactive use.

b. Qualcomm Mirasol display's significant advantage in efficiency enables distinct overall battery life advantages when applied to a wearable device use case:
   - **14 Days of battery life for Toq design** - In a highly optimized device system, such as those available via the Qualcomm Toq reference design platform, the Mirasol display enables up to 14 days of always on, always useful battery life[1]
   - In an apples to apples comparison, OLED gets 2 days, LCD = <1day
   - **2X Battery life of OLED/LCD in non-Toq design** - In a system not leveraging a Toq reference design, a Mirasol display-based device will, on average, exceed the battery life of OLED and LCD by at least 2X.
   - See Table below:

**Battery Life as a Function of System & Display Current**




1 - In this model, the total average current for the entire system is .73mA, assumes a 300mAh battery and a mix of 23 hours of "always-on" and one hour of "interactive" (defined as all systems live) usage. Actual results may vary with differing battery sizes and when different usage models are applied.

**Always On, Always Useful**

a. Trends in mobile consumer behavior point to an increasing demand for always on and always useful experiences, specifically in the form of smart wearable devices:
    - **Driven by Context** - By 2015, 40% of the world's smartphone users will opt into context service providers that track their activities. (Gartner, 9/13)
    - **Glanceable, On Demand** - 67% of cell owners find themselves checking their phone for messages, alerts, or calls – even when they don't notice their phone ringing or vibrating. (Pew, 6/13)
    - **Immediate and Spontaneous** -
        i. 72% of Americans say they're within five feet of their smartphones the majority of the time. (Jumio 2013 Mobile Consumer Habits, 7/13)
        ii. 80% of smartphone activity is spontaneous. (Google/Sterling Brands/Ipsos, 8/12)
b. The need for always on and useful content dictates a specific set of enabling technologies, specifically the display technology, that can enable:
    - Low power consumption
    - Always Visible: Qualcomm Mirasol displays are reflective and therefore visible even in the brightest of sunshine.
    - Modern Display Attributes: Wearables are an extension of the mobile experience and consumers will carry along modern display performance expectations into wearables, to include:
        i. Color
        ii. Pixel Density / Resolution
        iii. Interactive Touch Interface

2. **Qualcomm's Toq Wearable Reference Design platform provides a cost-effective and accelerated path-to-market for OEMs. Reference design hallmarks:**
    a. Highly integrated system that can deliver weeks of always on, always useful battery life.
    b. Toq reference designs are market-ready solutions with SW, HW, evaluation, testing and engineering support available.
    c. BOM and component cost-advantages
    d. Technical innovation benefits include a mature, market-ready SDK that has already garnered 3rd party adoption, full SW (RTOS) stack, support of multiple mobile OS's, power management and optimization and local language support all the way through the UI.

3. **Qualcomm's next-generation of Mirasol display technology, termed "SMI", leverages the foundational technology building blocks of IMOD to deliver the same low-power, always on and outdoor visible experience with significant enhancements in visual and overall display performance.**
    a. Single Mirror IMOD (SMI) leverages a single reflective element to continuously sweep through the spectrum of available colors, stopping at the desired color. By comparison, the current Interferometric Modulator (IMOD)-based Mirasol displays leverage RGB stripes.
    b. SMI delivers a number of performance enhancements over the existing Mirasol display technology:

## SID 2014 MIRASOL DEMO PROFILES

### 5.1' Smartphone SMI Static Demo

| | |
|---|---|
| **Pixel Count:** 2560 x 1440<br>**Resolution:** 577 ppi<br>**Format:** QHD<br>**Contrast:** 43:1<br>**Color Gamut:** 74%<br>**Front Light:** Yes | • This static demonstration shows the significant jump in resolution, color quality and overall visual performance SMI-based Mirasol displays can deliver.<br>• Verbal only contrast and gamut<br>• Static = a type of rapid prototype used in lab environments to prove out the pixel architecture |

**Q: How much power do you expect an SMI-based 5.1" display at this pixel density to consume?**
**A:** This display will consume between 1/6 to 1/8$^{th}$ the power of comparably sized LCD, OLED when commercially available.

**Q: When will this SMI-based QHD display be available?**
**A:** This display is currently in development; we cannot publicly state a commercial availability date at this time.

**Q: Mirasol displays look different than an LCD and OLED – why?**
**A:** Mirasol displays are reflective, a very different approach to displays, as compared to LCD/OLED. These next-gen SMI demos, however, demonstrate the bright and colorful capabilities of the technology while still being low power enough to deliver days of always on battery life and clear, crisp visibility outdoors.

**Q: Will Qualcomm make this display/SMI-based Mirasol displays or will this be produced by a licensee?**
**A:** QMT is manufacturing the IMOD-based Mirasol displays commercialized. We have shifted our model, however, to a licensing-focused model moving forward.

**Q: Is 5.1" as large as you can make Mirasol displays?**
**A:** The 5.1" demo is the largest we are showing at SID Display Week 2014, but Mirasol displays can scale to

| 2.3” SMI Static Demonstration | |
|---|---|
| **Pixel Count:** 640 x 480<br>**Resolution:** 343 ppi<br>**Format:** VGA<br>**Contrast:** 44:1<br>**Gamut:** 74%<br>**Front Light:** No | • Demonstrates one of the varied formats currently being considered for SMI-based Mirasol displays.<br>• Ideal for golf, ruggedized cellphone, biking, outdoor action camera applications<br>• Verbal only contrast and gamut<br>• Static = a type of rapid prototype used in lab environments to prove out pixel architecture |

| 1.6” Wearable Static Demonstration | |
|---|---|
| **Pixel Count:** 384 x 384<br>**Resolution:** 343 ppi<br>**Format:** non-standard<br>**Contrast:** 44:1<br>**Gamut:** 74%<br>**Front Light:** No | • Demonstrates one of the varied formats currently being considered for SMI-based Mirasol displays.<br>• Ideal for diverse wearable device applications in smart watches, health, fitness, music-focused devices<br>• Verbal only contrast and gamut<br>• Static = a type of rapid prototype used in lab environments to prove out pixel architecture |

| 1.45” Wearable Static Demonstration | |
|---|---|
| **Pixel Count:** 352 x 352<br>**Resolution:** 343 ppi<br>**Contrast:** 44:1<br>**Gamut:** 74%<br>**Front Light:** No | • Demonstrates a slightly smaller iteration of the varied formats currently being considered for SMI-based Mirasol displays.<br>• Ideal for diverse wearable device applications in smart watches, health, fitness, music-focused devices<br>• Verbal only contrast and gamut<br>• Static = a type of rapid prototype used in lab environments to prove out pixel architecture |