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Let’s begin with where this thermal and power efficiency is visually demonstrated. The GPU is responsible for pushing millions of pixels to your display and does so up to 60 times each second. During gameplay it is called upon to render 3D worlds in ultra-realistic detail, all while the CPU may calculate the artificial intelligence of the game characters or the physics of the explosion you just caused. All these high performance tasks could make other SoCs burn a lot of power, and generate a great deal of heat. Snapdragon SoCs have a history of being cooler than the competition.

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Mobile devices have a very different set of thermal constraints. In the archaic PC segment, desktop computers are housed in large enclosures and are cooled by thick metal heat-sinks with a large and often loud fan. In contrast, mobile devices are mere millimeters thin and are expected to be held in your pocket, your hand, or against your cheek. There are certain thermal thresholds that must be met for a handheld to be a viable product. Skin temperature is one of them. If the devices’ thermal threshold is surpassed, the SoC begins to throttle back its frequencies, and thus performance, in an effort to reduce the heat. This can have negative impacts on performance and overall user experience.

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OEMs’ design decisions are able to help mitigate some of this heat. The proximity of high power components and the material used in the phone to dissipate the heat are some of the methods employed. Qualcomm Technologies, Inc. (QTI) actively works with OEMs to address their thermal needs. Before the handset is ever launched, QTI provides a thermal dashboard and model to help OEMs understand how their design decisions will impact performance and temperature. Still, metals, fancy plastics and PCB layout are not the only tools to solve this problem.

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Snapdragon processors are designed to enable lower power and thermal envelopes by a suite of features. The Adreno™ GPU is the visual center of Snapdragon, rendering 3D environments and painting pixels to your display. There are two different methods to render 3D images to the screen, deferred and direct rendering. Adreno utilizes both methods and dynamically switches between the two modes depending on which will deliver the best power efficiency. Deferred rendering breaks the scene into smaller tiles and renders them independently. Rendering smaller tiles consumes less memory and allows operations to remain on the GPU memory, and so these operations are not penalized for accessing the larger, longer latency external memory.

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Direct or immediate rendering does not buffer any content, but computes the scene as a whole and renders all pixels directly and immediately to the screen. While less efficient for accessing the external memory and potential overdraw, there are still some scenes or even parts of scenes that will benefit from this approach. Because it has the flexibility to decide between the two rendering methods based on the one that delivers the optimal power efficiency, this technology is called FlexRender™.

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Meanwhile Krait processors, the CPU of the Snapdragon SoC, are designed with aSMP, or asynchronous symmetrical multi-processing. Each CPU core is on an independent voltage plane. This allows each core to adjust its frequency to accomplish a task. While other SoCs force all cores to run at the same max frequency for a single-threaded task, Snapdragon allows that single active core to run at the needed speed while the others remain off or at a lower frequency.

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Of course, a phone is not a phone at all without a connection to the outside world, so Snapdragon optimizes its modem for power and thermal efficiency as well. There are high level reasons behind Snapdragon processors modem power efficiency. First, QTI creates and owns all of the key IP blocks of the modem, which allows for optimization at the system level. There are also performance and power improvements from one generation to the next. Second, QTI’s history of modem leadership is evidenced by the multi-generational lead over competition, and each design is more power efficient than the last.

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At the lower level, QTI has been the first to commercialize many features which enable power savings in LTE modems.

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Envelope tracking is one of the more recent QTI innovations in connectivity. This technology applies to the RF (Radio Frequency) amplifier, designed to allow the voltage to adjust to achieve peak power efficiency. The excessive power output (shown in the yellow below) is dissipated as heat. Snapdragon powered devices with this feature will reduce the thermal footprint and RF power consumptions by up to 30%. Snapdragon processors will be coupled with the industry’s first modem-assisted envelope tracking for 3G and 4G LTE devices.

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Connected Mode Discontinuous Reception (CDRX) can turn off the LTE receiver when data is not being actively sent or received. This simple idea can lead to significant system power savings, up to 15% lower power for web browsing and up to 20% for YouTube streaming. (See page 6 of this recent Qualcomm Technologies presentation for more info.)

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Not only is the Snapdragon SoC optimized for power consumption, but it also is designed to achieve the highest data rates. Starting with the Snapdragon 800 processor, QTI brought the first LTE-Advanced modem to the world. Coupled with Carrier Aggregation, Snapdragon processors can achieve speeds of up to double the previous generation. This massive speed boost can allow the phone to download your content quicker, preventing the modem from heating up over a longer period of time.

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QTI’s power saving features extend beyond silicon and into software. Snapdragon Battery Guru is an app designed to extend your battery life and longevity by automatically adjusting your smartphones settings. Upon installation, there is a brief learning period while the app learns your usage habits. Once it’s ready, it will disable certain features or apps when it knows you’re not using them. For example, it will learn that you are connected to a Wi-Fi signal at home from 6PM to 6AM, but during the workday, you’re only connected via 4G LTE. During the day, it will shut off your Wi-Fi connection so it is not burning unnecessary power searching for a connection. Or similarly, Snapdragon Battery Guru will recognize you do not conduct Skype calls in your sleep, so it will disable the connection to the internet if it is not needed. But if you do want to receive a Skype call at 2 a.m., Snapdragon Battery Guru allows for customization and you can override for each app as you see fit. Snapdragon Battery Guru is available on the Android Google Play store for your Snapdragon powered device.

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Beyond silicon, QTI even addresses thermals at the packaging level. Snapdragon processors are now housed in 4-channel PoP (package-on-package), which lowers the thermal resistance on the package by allowing for more heat transfer back into the circuit board. This technology can help keep the SoC up to 5 to 15 degrees Celsius (41 to 59 F) cooler. Lower temperature not only results in higher performance, but up to 30% lower leakage.

How does this all translate in the real world? Just take a look at the LG G2 smartphone. In a recent review by AnandTech, this flagship handset is topping the charts in CPU and GPU performance. Those high performance scores do not result in high power, as the G2 also took the top spots in their battery life tests. To quote the author, “The LG G2 battery life is shockingly good through our tests, and in subjective use.” In the talk time test, it lasted over 8 hours longer than the 2<sup>nd</sup> place contender and over 2.5x longer than the new iPhone 5s.

Not only do Snapdragon processor features allow for longer lasting battery life, but they allow for faster charging. With phones increasing in size, and battery technology improving, phones are slowly cramming more and more watt-hours or battery capacity into your device. The downside of this is that charge times also increase with battery capacity. Qualcomm® QuickCharge 2.0 improves charging by up to 75%. This more than compensates for the larger battery capacities and ensures you spend less time tethered to an outlet and more time on the go. Check out what was said about QuickCharge here.

The smartphone continues to evolve, both inside and out. These changes are opening up new worlds of usage models and capabilities that we previously wouldn’t have imagined could be housed in our pocket. With the sizeable list of engineering innovations discussed here, Snapdragon processors have paved the way for this mobile revolution. If you want the best performance and the best battery life, you want a Snapdragon processor at the heart of your device.

Our next post will explore some of the new user experiences enabled by these exciting Snapdragon features and others.

Second blog post on the power and thermal challenges that face modern devices.

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Adam is a Senior Marketing Manager on the Snapdragon integrated marketing team. Prior to joining Qualcomm in 2013 Adam spent 7 years with Intel, where he created and managed the SoC power and performance analysis team. Outside of the office, chances are he is crawling through mud or hiking with a bag full of bricks, training for his next extreme endurance event.

Adam earned his BS in Electrical and Computer Engineering from Cornell University.

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Snapdragon mobile platforms are designed with power efficiency to get you through the day on a single charge. With each generation, Snapdragon mobile platforms get better at meeting the demands of the power user. Take the Snapdragon 835. Compared to its predecessor, the Snapdragon 821, the Snapdragon 835 boasts a greater-than 25 percent power reduction. This allows you to do more power intensive activities on a single charge, such as VR gaming and 4K video streaming. While the goal is to get you through a day, or more, without the need to recharge, there will undoubtedly be the occasional need to reach for the power cord. That’s when Quick Charge can save the day.

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When Quick Charge 4 was announced, it promised to bring even faster charging than its predecessor, allowing a device to go from empty to 50 percent in just 15 minutes. We added new technologies designed to further extend battery cycle life, enhance safety, and expand charging intelligence. These features come standard with a device that includes Quick Charge 4.

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But we haven’t been resting on our accomplishments since then. In fact, since that time we developed new enhancements and created a special program for those device and accessory manufacturers who design their products with these new features included. We call this the “plus” program, as in Quick Charge 4+.

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On the mobile device side, Quick Charge 4+ includes all the benefits of Quick Charge 4, plus three enhancements. Manufacturers get the 4+ designation by including all three:

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Dual Charge: already an option in earlier versions, but now more powerful, Dual Charge includes a second power management IC in the device. Charging a device via Dual Charge divides the charge current, allowing for lower thermal dissipation and reduced charge time

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Intelligent Thermal Balancing: a further enhancement to Dual Charge, intelligent thermal balancing is engineered to move current via the coolest path autonomously, eliminating hot spots for optimized power delivery

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Advanced Safety Features: Quick Charge 4 already includes rigorous built-in safety protocols. Quick Charge 4+ goes one step further and is designed to monitor both the case and connector temperature levels simultaneously. This extra layer of protection helps ward against overheating and short-circuit or damage to the Type-C connector.

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With Dual Charge, Intelligent Thermal Balancing, and Advanced Safety Features incorporated in a device design, that device has the potential to charge up to 15 percent faster, or 30 percent more efficiently when compared to Quick Charge 4.

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Accessories such as wall adapters, car chargers, portable battery banks, and USB hubs can also qualify for Qualcomm Quick Charge 4+ designation. Such an accessory will include backward compatibility with Quick Charge 3.0 and Quick Charge 2.0. Having a 4+ certified accessory will help ensure that your existing Quick Charge 3.0 and 2.0 enabled devices will work with the latest commercially available adapters.

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Manufacturers meeting the device or accessory requirements can use the 4+ logo on their products. Qualcomm Technologies will also include each of these in the Quick Charge certified device list so consumers will have an easy means to find qualifying products. Remember, not all power adapters are created equal. That’s why Quick Charge accessories go through a rigorous certification process to ensure they meet the stringent requirements set forth by UL.

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Just this week, the first device to include Quick Charge 4+ support was announced, the nubia Z17. The nubia Z17 is one powerful smartphone featuring, in addition to Quick Charge 4+ and a 3200mAh battery, the Snapdragon 835 mobile platform with an impressive 8GB RAM and 128GB memory, 23+12 megapixel dual rear camera, and a 5.5” FHD frameless display.

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With Quick Charge 4+, Qualcomm Technologies once again shows our leadership in charging technology. Since the first products came out over 4 years ago, Quick Charge technology has been included in over 130 mobile devices and 475 accessories, making it the most popular fast charging technology available by a wide margin. Quick Charge 4+ continues the fast charging innovation, providing design flexibility for manufacturers, and a diverse ecosystem of certified products for consumers. Be sure to look for Quick Charge 4+ in your next mobile device.

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The man behind the world’s most popular mobile OS is at it again: Andy Rubin, co-founder of Android, this week launches Essential Products, “a new kind of company to build solutions for the way people want to live in the 21st century.” That first solution — the Essential Phone powered by the Qualcomm Snapdragon 835 Mobile Platform — is debuting as well.

Why Qualcomm Technologies? According to Essential Products Vice President of Hardware Joe Tate, “We evaluated all of the available mobile processing solutions for our device. This SoC is the world’s first mobile SoC fabricated with a 10nm process. The advanced manufacturing process, along with the custom heterogeneous computing architecture, uses 35 percent less board area and 25 percent less power than the previous generation flagship processor.”

That extra space in the Essential Phone can accommodate a bigger battery, a 3040mAh cell, which means long battery life. “Although the cell is larger than other mobile devices, charging isn’t compromised with our miniature 27W USB Power Delivery adapter, allowing for exceedingly fast recharge times without compromising battery safety,” says Tate.

Thanks to the Snapdragon 835, you’ll enjoy high-end graphics courtesy of the Qualcomm Adreno 540. The GPU, which is 25 percent faster than its predecessor, is designed to deliver real-life-quality visuals for exciting immersive experiences. The Essential Phone incorporates additional Qualcomm Technologies solutions, including the Snapdragon X16 LTE modem and Qualcomm TruSignal technology, which as Tate asserts, “is engineered to maximize internet speed and performance, and allow you to connect to almost any cellular network in the world.” The Snapdragon modem also integrates 802.11ac with 2x2 MU-MIMO, designed to supercharge your Wi-Fi connections even in crowded places. The Essential Phone’s built-in High Power UE (HPUE) support for extended cellular coverage is powered by Qualcomm Technologies’ envelope tracking technology for superior power efficiency and long battery life.

The Essential Phone isn’t just premium on the inside; the sleek and durable phone features a 5.72-inch bezel-less display with a titanium enclosure, a ceramic back, and Gorilla Glass 5. While beautiful, the edge-to-edge display can be a challenge for traditional touch controllers; they’re either incapable of supporting such a display or they don’t perform adequately. That’s why Essential is using the Qualcomm improveTouch technology. High-performance touch-processing algorithms and noise filters, which run on the 835’s Qualcomm Hexagon DSP, provide a fluid user experience in virtually any environment. So, even in rainy conditions, the phone will support wet, multi-finger tracking (in other words, a great touch user experience).

The company also relied on Snapdragon for its Essentials 360 camera, a miniature magnetic attachment that you can use to capture brilliant 360° videos and photos. The camera integrates the Snapdragon Connected Camera Platform, which features the Snapdragon 625 SoC.

Essential’s flagship phone is the first and central component of Rubin’s vision for a connected future — one where “everything just happens like you think it should,” as Tate describes it. Next up in Essential’s play-nice-with-everyone ecosystem: a home assistant simply called Home.

You can reserve your Essential Phone in Black Moon or Pure White (Stellar Grey and Ocean Depths coming soon) as well as a 360-degree camera accessory on the Essential.com web site.

Qualcomm Adreno, Qualcomm Hexagon, Qualcomm Snapdragon and Qualcomm TruSignal are products of Qualcomm Technologies, Inc. Qualcomm improveTouch technology, a feature of Qualcomm Snapdragon processors, is a product of Qualcomm Technologies, Inc.

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We envision a future where technology will become more personalized and even more useful — one where your world will be intuitively augmented to fit your needs, and it will all happen seamlessly wherever you are. Over time, the technology itself will effectively disappear, as a new type of almost imperceptible mobile device emerges to replace nearly all others and change how we interact with the world. While there are many technology hurdles to overcome before all of that happens, some of it is already just starting, and maybe even sooner than you think through a convergence of technologies under Extended Reality (XR).

XR is an umbrella term encapsulating Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), and everything in between. Today AR and VR are distinct experiences, but they share many of the same underlying technologies that will power revolutionary XR experiences as AR and VR eventually converge into a new type of wearable device that’s capable of supporting both. XR will transform everyday consumer experiences and many market verticals, from industrial manufacturing and health care to education and retail. The possibilities are endless with XR. Mobile XR has the potential to become one of the world’s most ubiquitous and disruptive computing platforms of the next decade, just as the smartphone of this decade has become. And it’s why we are determined to accelerate the development of the key technologies required for XR adoption. It’ll only happen if technology leaders work together with the consumer in mind. Therefore, it is our hope that we can collectively cast aside the dogma of the past, save some breath, and make XR happen together.

XR glasses will provide the functionality of AR, VR, and a smartphone."},"title":"","alt":"","width":560,"height":360}],"type":"html","value":"



The XR wearable will be a converged device

\nAt some point in the future, we see the convergence of the smartphone, mobile VR headset, and AR glasses into a single XR wearable. In this scenario, a single pair of XR glasses will be used primarily for AR but will also be used occasionally for VR — the otherwise transparent glasses will have a mode where they become completely opaque and enter a “VR mode.” The XR glasses will of course need to be sleek, comfortable, and fashionable while providing immersive, cognitive, and always-connected experiences that truly enhance and enrich our lives. XR glasses could replace many other screens in your life — even big ones like the TV in your living room. We believe at some point in the next decade, they’ll eventually become the most commonly used device for conveying audio and visual information to humans worldwide.

\nSolving the key XR technology challenges ahead

\nAll that said, XR will not happen without substantial technology innovation. There are many technical challenges that need to be solved before XR reaches mainstream adoption, but for now let’s just focus on these five:

\n**Display:** XR needs a disruptive revolution in display technology. XR will require richer visual content and the ability to seamlessly switch between virtual and real worlds. Besides being comfortable and durable, XR displays will need to solve a myriad of challenges, such as the vergence-accommodation conflict. This is a physiological characteristic of the human visual system that if not properly accounted for, causes fatigue and discomfort when your eyes rotate and focus on objects at different perceived distances. It will also be a substantial challenge, albeit not an insurmountable one, to have the same displays enable application-controlled transparency and opaqueness, along with a wider field of view (FoV), substantial improvements in pixel density, higher frame rates, and increased brightness.

\n**Common illumination:** Making virtual objects in augmented worlds visually indistinguishable from real objects is a tremendous challenge, but it’s a challenge that needs to be overcome for XR to reach its potential. We need further convergence between the disciplines of computer vision and 3D graphics to deliver common illumination between virtual and real objects. This way, for example, a virtual picture frame of your family that you choose to place on your desk (wherever you are sitting) will be indistinguishable from a real one, under any lighting condition.

\n**Motion tracking:** Intelligent on-device tracking of our head, hands, and eyes is required to interact intuitively with our XR glasses and create immersion. For example, low-latency and precise inside-out 6 Degrees of Freedom (6 DoF) head tracking is required to meet the motion-to-photon latency of world-scale VR. Also, for most use cases, the best controller is no controller, so hand tracking in AR-mode and creating realistic virtual hands in VR-mode are essential. We also think that the use of eye tracking for automatic inter-pupillary distance (IPD) calibration, more efficient 3D graphics and video foveated rendering for enhanced visual quality, and new user interfaces designed for XR to create more natural intent-based interaction will be essential.

\n**Power and thermal:** Accommodating the always-on, compute intensive workloads of XR within the power and thermal constraints of sleek XR glasses is very challenging. Improvements in heterogenous computing performance per watt, battery technology, materials science, software efficiency, and standardization are required across the ecosystem to meet our vision of ubiquitous XR.

\n**Connectivity:** XR also requires ubiquitous and seamless connectivity to the internet and cloud services, initially served by Gigabit LTE and complemented with Wi-Fi. As we see more and more XR users with higher-quality immersive services, we will need the additional capacity that 5G provides. The streaming of XR video is expected to become the killer 5G use case in the next decade. As an example, XR video can require gigabits of bandwidth and very low latency for demanding 6 DoF video experiences. 5G enhanced mobile broadband will provide multi-gigabit throughput, as well as over-the-air latency down to 1 millisecond to help to improve the speed of interaction with streaming XR video applications. 5G will also help deliver a more uniform XR experience since data rates with 5G will not vary as much as they currently do today, when you are further away from the base station.

\nAccelerating XR adoption

\nThis is a big challenge. We know that we can’t do this alone. Achieving our XR vision will take significant R&D and cooperation amongst the world’s top mobile hardware and software technology companies. However, Qualcomm has already started to work with some of these companies to embark down the XR path together, with a goal to collectively solve some of these difficult technical challenges that will eventually enable a future where XR glasses will progressively become sleeker and offer tremendously more functionality. We’re currently in the early days of a multi-decade XR evolution — similar to the smartphone evolution from the bulky mobile phone to today’s sleek smartphone.

\nHere at Qualcomm, we’ll be doing our part to help drive XR forward. We are committed to delivering superior mobile XR processing at low power consumption. We’re developing the foundational technology required for XR, such as ultra-low power, immersive 3D graphics and camera subsystems with improvements specifically for XR, as well as converged computer vision, machine learning, intuitive security, Gigabit LTE, and 5G technologies to make future XR devices even more intuitive and connected. We’re also working with the ecosystem and investing in leading XR companies — all in an effort to make our vision of XR a reality sooner.

\nWant to learn more? Be sure to check out our XR presentation and website. Also, sign up for our newsletter to receive the latest information about mobile computing.

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Attendees at Computex will be able to experience a Windows 10 PC prototype, for the first time powered by the flagship Qualcomm Snapdragon 835 Mobile PC Platform. With the first-ever launch of sleek, innovative, fanless devices running Windows 10 PC devices powered by Snapdragon 835 are expected to be available from Asus, HP, and Lenovo.

In December at Microsoft’s Windows Hardware Engineering Conference (WinHEC), Microsoft’s Terry Myerson (EVP, Windows and Devices Group) invited Qualcomm Technologies’ Cristiano Amon to the keynote to announce that Windows 10 is coming to the premium-tier Snapdragon platform.

Consumers will get the Windows 10 experience they know and love. With Snapdragon, hardware makers can create Windows 10 PCs that are thin, light, fan-less, and designed to deliver long battery life. With the integrated Snapdragon X16 LTE modem, your Windows 10 device can support blazing fast Gigabit internet speeds for a virtually anytime, anywhere experience.

The device on display at Computex is running on our small development platform, but it’s set up like a desktop PC. We attached a 46-inch monitor, wireless keyboard, and wireless mouse, and loaded it with familiar apps like Microsoft Office and other great apps so attendees can experience productivity and entertainment on Windows 10 powered by Snapdragon. We’ve also set up a Gigabit LTE network so attendees can experience the extreme speed supported by the integrated Gigabit LTE modem.

Stay tuned for more information as we launch sleek, innovative, fanless devices running Windows 10 PCs powered by the Snapdragon 835 Mobile PC Platform.

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OnQ Blog



# The Thermal Efficiency Behind Smartphone Trends

2013年10月9日

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In our second blog post on the power and thermal challenges that face modern devices, we will explore the current trends in the industry and the technologies and innovations that make them possible.

- Read the first in our series: [Smartphone Battery Life and SoC Power Benchmarking](#)

Our phones are getting bigger. As the capabilities of smartphones have grown, so have their screens. The increased demand for more visual real-estate on our pocketable devices is a global trend. According to ABI Research, almost 83 million phablets, or phones with a five inch screen or greater, were shipped in 2012. That is an increase of 4,504% from 2011. The same body of ABI Research also states that shipments of such phones are expected to grow to 273 million in 2017.

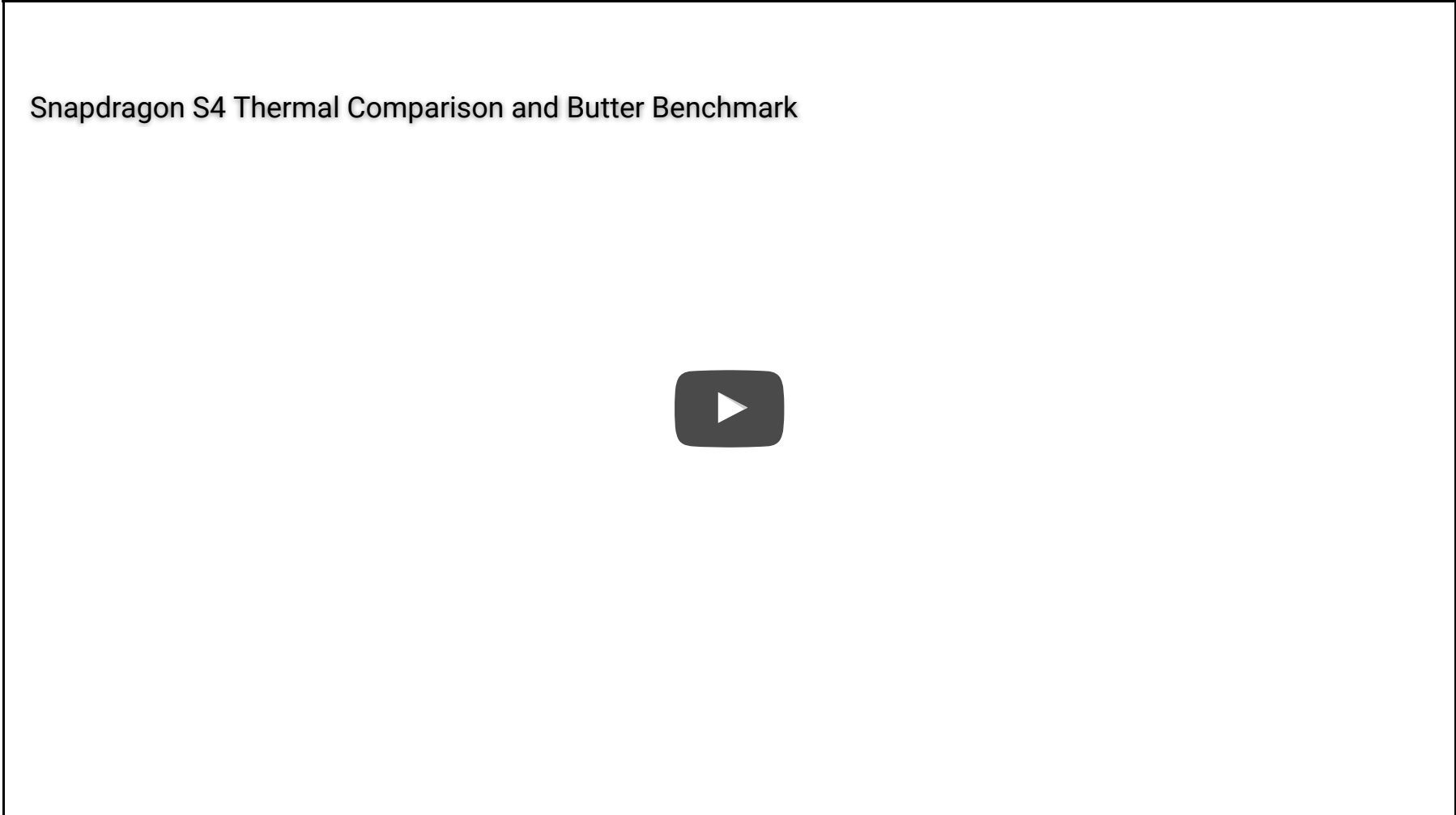
Not only are these screens bigger, but they are higher resolution, which means they consume more power and require more processing horsepower. Almost every standard flagship phone today has at least a 1080p screen. Tablet resolutions are even higher, with Qualcomm Snapdragon 800 processors supporting up to 2560x2048. Armed with these larger screens and crisper resolutions, users are able to demand more from their devices. After all, watching HD video or gaming on 6” phablet is a much more immersive experience compared to the 3” pixelated phones of yesteryear.

One might expect that if mobile devices’ horsepower increased to enable these new experiences, the thickness of the device would grow as well to compensate for the added power and heat from these components. In reality, the exact opposite is true. Tablets and smartphones are getting thinner. For example, the [Sony Xperia Z Ultra](#) powered by the [Snapdragon 800 processor](#), weighs in with a massive 6.4” display, but launched as the “world’s thinnest HD smartphone,” at only 6.5mm.

To recap: larger screens, higher resolutions, and SoCs with more horsepower, yet devices are getting thinner. How is all of this possible? The answer is great engineering.

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Let’s begin with where this thermal and power efficiency is visually demonstrated. The GPU is responsible for pushing millions of pixels to your display and does so up to 60 times each second. During gameplay it is called upon to render 3D worlds in ultra-realistic detail, all while the CPU may calculate the artificial intelligence of the game characters or the physics of the explosion you just caused. All these high performance tasks could make other SoCs burn a lot of power, and generate a great deal of heat. Snapdragon SoCs have a history of being cooler than the competition.



Mobile devices have a very different set of thermal constraints. In the archaic PC segment, desktop computers are housed in large enclosures and are cooled by thick metal heat-sinks with a large and often loud fan. In contrast, mobile devices are mere millimeters thin and are expected to be held in your pocket, your hand, or against your cheek. There are certain thermal thresholds that must be met for a handheld to be a viable product. Skin temperature is one of them. If the devices’ thermal threshold is surpassed, the SoC begins to throttle back its frequencies, and thus performance, in an effort to reduce the heat. This can have negative impacts on performance and overall user experience.

OEMs’ design decisions are able to help mitigate some of this heat. The proximity of high power components and the material used in the phone to dissipate the heat are some of the methods employed. Qualcomm Technologies, Inc. (QTI) actively works with OEMs to address their thermal needs. Before the handset is ever launched, QTI provides a thermal dashboard and model to help OEMs understand how their design decisions will impact performance and temperature. Still, metals, fancy plastics and PCB layout are not the only tools to solve this problem.

Snapdragon processors are designed to enable lower power and thermal envelopes by a suite of features. The Adreno™ GPU is the visual center of Snapdragon, rendering 3D environments and painting pixels to your display. There are two different methods to render 3D images to the screen, deferred and direct rendering. Adreno utilizes both methods and dynamically switches between the two modes depending on which will deliver the best power efficiency. Deferred rendering breaks the scene into smaller tiles and renders them independently. Rendering smaller tiles consumes less memory and allows operations to remain on the GPU memory, and so these operations are not penalized for accessing the larger, longer latency external memory.

Direct or immediate rendering does not buffer any content, but computes the scene as a whole and renders all

pixels directly and immediately to the screen. While less efficient for accessing the external memory and potential overdraw, there are still some scenes or even parts of scenes that will benefit from this approach. Because it has the flexibility to decide between the two rendering methods based on the one that delivers the optimal power efficiency, this technology is called FlexRender™.



Meanwhile Krait processors, the CPU of the Snapdragon SoC, are designed with aSMP, or asynchronous symmetrical multi-processing. Each CPU core is on an independent voltage plane. This allows each core to adjust its frequency to accomplish a task. While other SoCs force all cores to run at the same max frequency for a single-threaded task, Snapdragon allows that single active core to run at the needed speed while the others remain off or at a lower frequency.

The Power of the Snapdragon™ Processor: Asynchronous Processing

Of course, a phone is not a phone at all without a connection to the outside world, so Snapdragon optimizes its modem for power and thermal efficiency as well. There are high level reasons behind Snapdragon processors

modem power efficiency. First, QTI creates and owns all of the key IP blocks of the modem, which allows for optimization at the system level. There are also performance and power improvements from one generation to the next. Second, QTI's history of modem leadership is evidenced by the multi-generational lead over competition, and each design is more power efficient than the last.

At the lower level, QTI has been the first to commercialize many features which enable power savings in LTE modems.

Envelope tracking is one of the more recent QTI innovations in connectivity. This technology applies to the RF (Radio Frequency) amplifier, designed to allow the voltage to adjust to achieve peak power efficiency. The excessive power output (shown in the yellow below) is dissipated as heat. Snapdragon powered devices with this feature will reduce the thermal footprint and RF power consumptions by up to 30%. Snapdragon processors will be coupled with the industry's first modem-assisted envelope tracking for 3G and 4G LTE devices.



Connected Mode Discontinuous Reception (CDRX) can turn off the LTE receiver when data is not being actively sent or received. This simple idea can lead to significant system power savings, up to 15% lower power for web browsing and up to 20% for YouTube streaming. (See page 6 of [this](#) recent Qualcomm Technologies presentation for more info.)

Not only is the Snapdragon SoC optimized for power consumption, but it also is designed to achieve the highest data rates. Starting with the Snapdragon 800 processor, QTI brought the first LTE-Advanced modem to the world. Coupled with Carrier Aggregation, Snapdragon processors can achieve speeds of up to double the previous generation. This massive speed boost can allow the phone to download your content quicker, preventing the modem from heating up over a longer period of time.

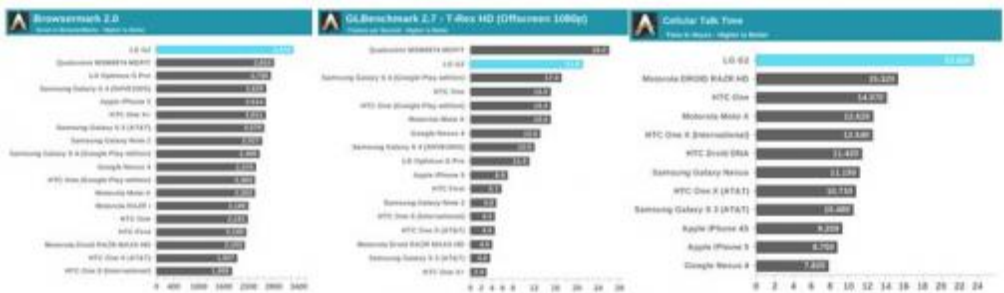
QTI's power saving features extend beyond silicon and into software. Snapdragon Battery Guru is an app designed to extend your battery life and longevity by automatically adjusting your smartphones settings. Upon installation, there is a brief learning period while the app learns your usage habits. Once it's ready, it will disable certain features or apps when it knows you're not using them. For example, it will learn that you are connected to a Wi-Fi signal at home from 6PM to 6AM, but during the workday, you're only connected via 4G LTE. During the day, it will shut off your Wi-Fi connection so it is not burning unnecessary power searching for a connection. Or similarly, Snapdragon Battery Guru will recognize you do not conduct Skype calls in your sleep, so it will disable the connection to the internet if it is not needed. But if you do want to receive a Skype call at 2 a.m., Snapdragon Battery Guru allows for customization and you can override for each app as you see fit. [Snapdragon Battery Guru is available on the Android Google Play store for your Snapdragon powered device.](#)





Beyond silicon, QTI even addresses thermals at the packaging level. Snapdragon processors are now housed in 4-channel PoP (package-on-package), which lowers the thermal resistance on the package by allowing for more heat transfer back into the circuit board. This technology can help keep the SoC up to 5 to 15 degrees Celsius (41 to 59 F) cooler. Lower temperature not only results in higher performance, but up to 30% lower leakage.

How does this all translate in the real world? Just take a look at the [LG G2 smartphone](#). In a [recent review by AnandTech](#), this flagship handset is topping the charts in CPU and GPU performance. Those high performance scores do not result in high power, as the G2 also took the top spots in their battery life tests. To quote the author, “The LG G2 battery life is shockingly good through our tests, and in subjective use.” In the talk time test, it lasted over 8 hours longer than the 2<sup>nd</sup> place contender and over 2.5x longer than the new iPhone 5s.



Not only do Snapdragon processor features allow for longer lasting battery life, but they allow for faster charging. With phones increasing in size, and battery technology improving, phones are slowly cramming more and more watt-hours or battery capacity into your device. The downside of this is that charge times also increase with battery capacity. Qualcomm® QuickCharge 2.0 improves charging by up to 75%. This more than compensates for the larger battery capacities and ensures you spend less time tethered to an outlet and more time on the go. Check out what was said about QuickCharge [here](#).





<script language="JavaScript" type="text/javascript" src="http://admin.brightcove.com/js/BrightcoveExperiences.js"></script><script type="text/javascript">brightcove.createExperiences();</script>

The smartphone continues to evolve, both inside and out. These changes are opening up new worlds of usage models and capabilities that we previously wouldn’t have imagined could be housed in our pocket. With the sizeable list of engineering innovations discussed here, Snapdragon processors have paved the way for this mobile revolution. If you want the best performance and the best battery life, you want a Snapdragon processor at the heart of your device.

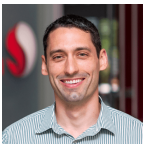
Our next post will explore some of the new user experiences enabled by these exciting Snapdragon features and others.

Snapdragon

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