To

Mobile and Laptop Hardware
(Including Tablet, Ultrabooks and Hybrids)

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• Mobile hardware - GPU
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• Complete buying guide including top 10 devices
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FAST TRACK to
MOBILE AND LAPTOP HARDWARE
Unity in Diversity
In a continually evolving ecosystem, portability is the name of the game. Soon all your computing needs will be fulfilled by non-desktop PCs and other devices

Mobile Hardware: System on Chip
Snapdragon, Tegra, Exynos and the likes... Are they code names for processors? Let us give you a lowdown on the heart of your mobile device - the System on Chip

Mobile Hardware: GPU
In the previous chapter we gave you a peek into the world of SoCs, and primarily its CPU component, here we look at the fabled GPU

Mobile hardware - Other Components
When it comes to performance parameters, we always seem to care about the CPU and GPU most. The other components play an equal role

Mobile and tablet software
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Introduction

While PC enthusiasts will forever remain true to their geek roots, there’s no doubt computing is steadily moving towards the portable space. Take a look around you; tablets, smartphones and laptops are ubiquitous, and reports of desktop sales dropping are more common than the next iteration of a brand new Galaxy phone.

This got us thinking... How much does the average user really know about the innards of his or her mobile device? In the case of mobile phones, specifications read like career-criminal rap sheets. You constantly come across terms such as Snapdragon, Tegra, Exynos and the likes. What do these arcane terms mean? Most people believe these are just names of processors – a common misconception. In reality these are SoCs or System On Chips. In the case of laptop hardware, it’s easy to assume the speed of the CPU is a measure of its performance. Surely a 3.4 GHz model is faster than a 3.1 GHz model. Not necessarily. While the clock speed-to-performance ratio is stable within the same family of processors, the amount of work done per clock cycle is different for each processor architecture and family. Many more clock cycles may be required by one CPU compared to another to do the same amount of work if they belong to different families. This FastTrack aims to debunk many such misconceptions, effectively making you a portable hardware wiz. With this firm grounding, buying advice will become second nature to you. For instance, say you’re on the market for a new laptop. Do you know how to identify new generation Sandy Bridge processors from their older variants just by looking at the model number? With this FastTrack you will.

In addition to all this we provide a comprehensive and handy buying guide to wrap things up. The buying guide is complete with our Top 10 recommendations in each of the categories viz. Mobile, Tablet and Laptop.

As always happy reading, and we look forward to your feedback on editor@thinkdigit.com
UNITY IN DIVERSITY

In a continually evolving ecosystem, portability is the name of the game. Soon all your computing needs will be fulfilled by non-desktop PCs and other devices.

Generation Z takes mobile devices for granted since kids born in this era remember them always being around. Technology, however, is improving constantly and changes such as the way we connect with each other are easily obvious. For instance, SMS is already dying with apps such as Facebook Messenger and WhatsApp taking its place. Another advancement is the increased use of mobile devices to access content, in turn boosting mobile sales. The likes of the netbook are resulting casualties.

Majority of the time, we just want things to work. As long as the gadget does what it was purchased to do, half a kilo of extra weight or half an inch less of screen space doesn’t really matter. Think: your personal computer or that bulky yet powerful laptop you’re still lugging around. Despite portability being an issue, the PC is here to stay – be it for the enthusiast, office personnel, gamer or programmer. It’s still relevant in an age where we
want to access our heavy files everywhere (ask us, we design most of your beloved magazine on a PC). Accessing them via the cloud is barely a solution since we often work with ginormous sized files and storage space is limited. However, like we said, portability remains an issue, bringing to the forefront the important difference of size between desktops and mobile devices. Functionality of the latter despite their compactness can be attributed to the hardware. In this Fast Track, we’ll be discussing the hardware used in mobile devices, covering the three broad categories: mobiles, tablets and laptops (including ultrabooks, of course).

**Mobiles**

“When you think about your iPhone, it’s probably the object you use most in your life” says Senior VP of Industrial Design at Apple, Jony Ive when introducing iPhone to the visitors of Apple’s website. Whether or not your smartphone has an ‘i’ in front of its name, you do use it all the time. If it’s too big, it’s hard to keep in your pockets. If it’s too small, it doesn’t display images, web pages and videos at their optimal viewing size. Screen sizes ranging from 3.5 inches to 5.5 inches exist in the market, and chances are that your mobile phone doubles up as a camera, information provider, GPS system, music system and wallet, among its many other personas. It does it all, and its indispensability is the reason for it always being with you.

**Tablets**

Here comes the netbook killer. The ultimate reading device, gaming device and multimedia device all rolled into one. Users have a love-hate relationship with tablets – loved for its size and hated for the same reason when it comes to carrying out different tasks. The size is viable
for reading or watching videos, however, try answering or making a call on a tablet. Heads will turn; not in envy but in amusement. Users have found a workaround to this by employing hands-free devices but that’s an additional cost. Yet we use them and want a better model each year. Screen sizes start at 7 inches and go up to 13 inches. They can do almost everything a phone can (except be small) and hence are just as useful!

**Laptops**

Notebooks/laptops and ultrabooks are inarguably the most essential of the bunch. They come equipped with an onboard keyboard, camera and mouse, and are powerful computing devices with adequate size displays. These productivity machines rate low on ease of portability but the likes of laptop-cum-tablets such as the Asus Transformer Pad are stamping out this shortcoming. Combined with a mobile, such devices might just complete all your requirements of computing! The combination is perfect for people who want more than just content-consumption from a computer. Screen sizes of 14 and 15 inches are the most common.

Which mobile device would we pick as the best of these? All of them. You can’t just click pictures on your phone and enjoy them on the same small screen. When you want to type fast or compile your college project, tablets are a bad idea and of course it’s best to talk to your buddy using a phone rather than a tablet but you’d prefer reading a thriller novel on a tablet rather than on a mobile or a laptop. In the chapters that follow, we’ll elaborate on the physical components of these devices, their functions, design and reasons for this design.
Unless you have been living under a rock, you may have come across terms such as Snapdragon, Tegra, Exynos and the likes, while browsing through mobile phone or tablet specifications. A common misconception among many is that these are code names for processors. So what are these things and what role do they play as far as the mobile device hardware goes? Let us give you a lowdown on the heart of your mobile device – the System on Chip.
The term System-on-Chip refers to the chip housed in your mobile device, which pretty much functions as a complete computer. Now while desktop systems have a separate processor, separate GPU (except for those systems with integrated processors), separate controllers to handle the peripheral devices and so on, that is not the case with mobile devices such as tablets and cellphones. All of the discrete components seen on the desktop need to be integrated within one single chip and that implementation is called as the System-on-Chip (SoC).

So the SoC is basically an integrated circuit, with all the parts of a computer on one single chip. The SoC is what defines a mobile device and it contains within it the processor cores, the graphics chips, the cellular radios, mobile RAM, image processors, audio/video decoders and so on. The consolidation of all these seemingly separate-function parts on a single chip also helps in keeping the power requirements lower. These days you get SoCs which can easily beat the desktop system configs from say five years back. And with every successive generation the SoCs are getting even more impressive.

For the desktop systems we have Intel who design and manufacture their own chips. But in the mobile space ARM Holdings, a British company, is the bigger name. Unlike Intel, ARM Holdings makes the processor refer-
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ence design which is licensed to SoC makers such as Qualcomm, Apple, Samsung and so on. Alongwith the processor designs, ARM also licenses the instruction sets to go along with the designs for third party SoC makers. They add on other components which will make up the SoC on top of the reference design and some like Qualcomm, even make changes to the processor micro-architecture. Apart from this, ARM licences its GPU reference designs as well.

The main players
Like we said before the System-on-Chip involves many players who use ARM’s designs and make their own SoCs. Qualcomm is the leader in this space and is the player to beat. It is to the mobile SoC space, what Intel is to the desktop CPU space. Qualcomm’s Snapdragon series of SoCs were first seen in 2007 in phones such as HTC Tattoo back in 2007 and ever since the number of phone and tablet makers using Qualcomm Snapdragon SoCs has just increased exponentially. With innovations such as fabricating a 4G LTE chip right onto the SoC die, Qualcomm has had the first mover advantage. The current generation involves the Snapdragon 200, 400, 600 and 800 series.

NVIDIA Tegra is the next SoC which is quite popular. Thanks to its parent company which has a proven track record in the graphics industry, NVIDIA first implemented a Tegra SoC in Microsoft Zune back in 2009. Tegra 2 was showcased at CES 2010 and this was followed by the first quad-core plus one companion core SoC – the Tegra 3 which was launched in the second half of 2011. According to NVIDIA, the four + one core configuration involves a low power companion core which is put on the SoC which has the quad-core Cortex A9 cores. The low power companion core is used to handle low power tasks such as background processes when the phone is idle, tasks such as web browsing among other things. The higher powered quad-cores kick in when the task is resource intensive such as
rendering, watching HD movies, gaming and so on. Its current iteration – the Tegra 4 – includes a quad-core ARM Cortex A15 plus one companion core.

Apple makes its own custom SoCs for the iOS products. The Apple A4 (housing a single core Cortex A8 processor) is the oldest SoC still seen in current 4th gen iPod whereas the most recent iteration is the A6 which is seen in the iPhone 5 and A6X seen in the iPad 4th gen. Apple A5 (housing a dual-core Cortex A9) is the most popular SoC as it's found on quite a lot of Apple devices currently in the market. Apple is probably the only SoC maker who hasn't yet come out with a quad-core processor configuration. Since it has complete control over both the software and hardware on its devices and since Apple SoCs are seen in its limited number of iDevices, we are seeing more power efficient SoCs, better graphics on their SoCs to handle the high-res Retina displays and high graphics iOS games and so on.

Samsung has a limited number of SoCs from its Exynos lineup which are seen mostly on their devices. It first came out with the Exynos 4 Quad with the quad-core Cortex A9 was seen in the Galaxy Note 10.1, Galaxy Note 8.0 and Galaxy Note II. The current generation includes the Exynos 5 Dual (dual-core Cortex A15 configuration) and the Exynos 5 Octa (quad-core Cortex A15 + quad-core Cortex A7 in the bit.LITTLE configuration). The Exynos 5 Octa is seen in Samsung Galaxy S4 and its processor cores work in the big.LITTLE configuration – lower power Cortex A7 takes over when running in the low power mode, whereas the higher end Cortex A15 processors are employed for heavy tasks such as gaming. So even though the SoC has the Octa naming convention, at a time you will have four cores working.

Off late we are seeing a lot of affordable smartphones which come with dual-core and sometimes even quad-core configurations. One look at the specs sheet of such devices and you will find one commonality - MediaTek. Its flagship model - the MT6589 SoC is seen in Micromax Canvas HD A116 which had us impressed for its value for money proposition.
The Processors
Cortex A series

The Cortex A series is the code name for the processor reference design from ARM and the series includes Cortex A5, Cortex A7, Cortex A8, Cortex A9, Cortex A12 and Cortex A15 reference designs with the A5 at the entry level side and the A15 meant for the high-performance mobile devices. Apart from being found in smartphones and tablets, the Cortex A series processors are also seen in digital TVs, media players, wireless networking devices, servers and so on. But for the purpose of the following pages we will only concentrate on their use in smartphones and tablets.

Cortex A15 is the flagship processor in the Cortex A series lineup and is meant for high-performance higher-end mobile devices. It is designed with advanced power reduction techniques and features an out-of-order superscalar pipeline for faster execution of instructions. The Cortex A15 will be bundled with other low power cores, to keep in line with ARM’s big.LITTLE technology. This is similar to NVIDIA Tegra’s 5th companion core. It basically allows the A15 to take care of the higher end tasks such as gaming, number crunching, rendering and so on while a lower powered processor core will take care of simpler tasks such as web surfing, background tasks in idle times and so on.

Krait

Qualcomm is the only company among the SoC makers which came out with its own processor for its SoCs. Krait was the successor to the hugely popular Scorpion processor and was first seen in the Snapdragon S4 lineup of Qualcomm SoCs. While the Scorpion could only be used in single and dual-core configurations, the Krait can be used in single, dual and quad-core configurations. Based on the 28nm manufacturing process, the Krait CPU was refreshed in 2013 when Qualcomm announced the Krait 300 and Krait 400 which will be seen in future Snapdragon devices. The Krait 300 will run at 1.9GHz whereas the Krait 400 can run at upto 2.3GHz. The Krait 300 will cater to more mainstream devices and will be seen in the Snapdragon 400 and Snapdragon 600 SoC sporting devices, whereas the higher end Krait 400 will be seen in the Snapdragon 800 SoC.
MOBILE HARDWARE: GPU

In the previous chapter we gave you a peek into the world of SoCs, and primarily its CPU component, here we look at the fabled GPU.

Before the advent of huge touchscreen phones the CPU was the only thing handling all the processing that a mobile application needed. Simply because given the processing capabilities of the CPUs of that generation the visual elements present in most applications were quite simple. The idea of providing a similar experience on smartphones and tablets akin to that found of desktops and laptops led to the adoption of a distributed architecture like what’s found on personal computers. So now, we have the SOC with a CPU and GPU on a single chip. Now, the entire graphical workload can be offloaded onto the GPU.

What is a GPU?
A Graphical Processing Unit, is that part of the SoC(System on Chip) that handles the image processing, 2D processing and also the 3D processing.
These kind of calculations are pretty simple, but the number of calculations per unit time is enormous. Which is why GPUs are RISC(Reduced Instruction Set Computer), i.e. they can handle a lot of simple calculations efficiently. CPUs on the other hand are more versatile and support a lot of instructions which makes them ideal for handling anything under the sun, however, this does mean that they take a significant hit in the time needed to perform calculations. So you now have an SoC where the CPU decides what needs to be calculated by whom and accordingly delegates the visual processing to the GPU, the audio processing to the audio processor and handles the rest of the workload by itself.

**How does it help then?**

While the CPU is capable of handling everything on its own in its own sweet time, the end result is a very laggy user experience. This is pretty evident in old Android devices where the delegation of graphical processing was not handled properly and the phones couldn’t play high-resolution videos. But this has changed, with instruction sets very similar to desktop variants being replicated on the mobile platform even playing 1080p videos have become a mainstream function on smartphones and tablets. Here is some of the tasks that a GPU commonly handles:

- Image processing (Adding various effects like B/W, Sepia, etc to photos)
- 2D processing (Mostly used to render elements of the user interface)
- 3D processing (Games and user interface elements)
- Video decoding and encoding (This is what helps play videos on your mobile device)

We can now play heavy duty games like Doom 3 on an android phone! Don’t believe us? Here is a link:

[http://dgit.in/19ljm6p](http://dgit.in/19ljm6p)

This might make you wonder why even with a GPU your device still lags quite a lot. Well this depends a lot on the way the operating system implements task handling and workload distribution. Variation of hardware is also a major factor. Take the Android OS, since Android was created to run on a plethora of different CPU & GPU combinations the programmers had to ensure that it worked smoothly on phones lacking powerful GPUs as well. So quite a lot of the graphical processing normally handled by the GPU was given to the CPU, purely for the sake of maintaining compatibility. That’s why an Android interface used to lag a bit even on powerful devices. But this was in the past, with Android 4.0, Google rightly took care of this issue
and now it has a very efficient method of delegating workload between the CPU and the GPU.

On devices which barely had to deal with any variety, i.e. Apple devices, the programmers can ensure a very efficient integration of the operating system with the hardware. This is why Apple's UI is very smooth even with a lot of apps installed. Windows phones are a different story, there are very few phones in the market so essentially it interface should be really smooth, however, the WP7 UI was made very graphic heavy, this mean that the GPU was now under heavy load and a characteristic lag would creep in after a few weeks of normal usage. Microsoft has fixed this with WP8. It is because of the sudden availability of extra processing power that these improvements were made possible, and also this is why your old Android, Apple or WP phone is not going to get the latest version of the OS. The hardware simply isn't enough to handle the new stuff.

**How many different GPUs exist?**

Since the number of operating systems are so few, the GPUs all have to be the same in its essence. This is done by ensuring that all GPUs utilise the same or at least similar instruction set. Usually manufacturers like to come up with their own instruction sets and hope they are adopted by others. This is pretty much what happened and now we have ARM Holdings Ltd., in the UK who comes out with new processor designs based on their own instruction set. This design is then licensed by other manufacturers and they modify them accordingly. Therefore, a lot of processors exist based on the most popular instruction set right now (ARMv7) which differ from each other by leaps and bounds. Then again there are companies that just license the instruction set (ARMv7) and come up with their own processor designs. The following companies are the popular players in the market:

- ARM
- DMP
- Imagem
- Imagination
- LogicBricks
- Nexus Chips
- Takumi
- TES-DST
- Think Silicon
- Vivante
<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>1920 X 1080 OFFSCREEN PLAYBACK (fps in brackets)</th>
<th>1920 X 1080 OFFSCREEN FILLRATE (Mtexels/s)</th>
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<tbody>
<tr>
<td>NVIDIA</td>
<td>Tegra 4</td>
<td>1027 Frames (18.3)</td>
<td>1332</td>
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<tr>
<td>Qualcomm</td>
<td>Adreno™ 320</td>
<td>957 Frames (17.1)</td>
<td>975</td>
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<tr>
<td>Imagination Tech</td>
<td>PowerVR SGX 554</td>
<td>940 Frames (16.8)</td>
<td>2074</td>
</tr>
<tr>
<td>ARM</td>
<td>Mali-T604</td>
<td>784 Frames (14.0)</td>
<td>1574</td>
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<td>Qualcomm</td>
<td>Adreno 305</td>
<td>754 Frames (13.5)</td>
<td>702</td>
</tr>
<tr>
<td>Imagination Tech</td>
<td>PowerVR SGX 544MP</td>
<td>708 Frames (12.6)</td>
<td>2076</td>
</tr>
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<td>Vivante</td>
<td>GC4000 core</td>
<td>393 Frames (7.0)</td>
<td>417</td>
</tr>
<tr>
<td>ARM</td>
<td>Mali-400 MP</td>
<td>381 Frames (6.8)</td>
<td>1077</td>
</tr>
<tr>
<td>Imagination Tech</td>
<td>PowerVR SGX 543</td>
<td>374 Frames (6.7)</td>
<td>1852</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno™ 305</td>
<td>354 Frames (6.3)</td>
<td>439</td>
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<td>Vivante</td>
<td>GC4000</td>
<td>334 Frames (6.0)</td>
<td>1092</td>
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<tr>
<td>Imagination Tech</td>
<td>PowerVR SGX 544MP2</td>
<td>265 Frames (4.7)</td>
<td>726</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno™ 225</td>
<td>260 Frames (4.6)</td>
<td>266</td>
</tr>
<tr>
<td>Broadcom</td>
<td>VideoCore IV HW</td>
<td>259 Frames (4.6)</td>
<td>326</td>
</tr>
<tr>
<td>Vivante</td>
<td>GC1000 core</td>
<td>243 Frames (4.3)</td>
<td>254</td>
</tr>
<tr>
<td>NVIDIA</td>
<td>Tegra 3</td>
<td>234 Frames (4.2)</td>
<td>622</td>
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<tr>
<td>Vivante</td>
<td>GC1000 MP core</td>
<td>207 Frames (3.7)</td>
<td>161</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno 225 (WDDM v1.2)</td>
<td>191 Frames (3.4)</td>
<td>188</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno™ 220</td>
<td>183 Frames (3.3)</td>
<td>151</td>
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<td>Imagination Tech</td>
<td>PowerVR SGX 535</td>
<td>152 Frames (2.7)</td>
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<td>PowerVR SGX 531</td>
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<td>472</td>
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<td>Vivante</td>
<td>GC2000 core</td>
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<td>317</td>
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<td>Qualcomm</td>
<td>Adreno™ 203</td>
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<td>PowerVR SGX 540</td>
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<td>714</td>
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<td>Qualcomm</td>
<td>Adreno™ 205</td>
<td>83 Frames (1.5)</td>
<td>235</td>
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<tr>
<td>NVIDIA</td>
<td>NVIDIA AP</td>
<td>78 Frames (1.4)</td>
<td>179</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno 205</td>
<td>74 Frames (1.3)</td>
<td>218</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno™ 200</td>
<td>33 Frames (0.6)</td>
<td>183</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Adreno</td>
<td>20 Frames (0.4)</td>
<td>170</td>
</tr>
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<td>PowerVR SGX 530</td>
<td>11 Frames (0.2)</td>
<td>199</td>
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<tr>
<td>Vivante</td>
<td>GC860 core</td>
<td>NA</td>
<td>83</td>
</tr>
<tr>
<td>Vivante</td>
<td>GC800 core</td>
<td>NA</td>
<td>84</td>
</tr>
<tr>
<td>ARM</td>
<td>Mali-300</td>
<td>NA</td>
<td>106</td>
</tr>
</tbody>
</table>
These companies create GPU solutions for devices like smartphones, tablets, portable media players, handheld consoles etc. It’s highly unlikely that you’re going to come across GPUs from all these companies in your local market so we are only going to cover the ones commonly used the smartphone and tablets available in India.

**Benchmarking**

Essentially all GPUs on the SoCs are pretty much similar due the same architecture that has been adopted by all of them. However, the operating system on top is a major factor to be considered. If two devices with the exact same hardware were to be tested and they both had different operating systems, then the benchmark scores will vary because the implementation of the operating system can have a huge effect. Conversely, if a device having hardware(A) using OS(A) scores more than device having hardware(B) and OS(B) does not imply that it is better in all aspects, there are bound to be variations where the overall low performer may be better than the overall high performer in one or two aspects.

Another factor is that there are a lot of variants of each GPU, which means that even if two devices share the same GPU the processing power can be vastly different given their variant type. For
example, let us consider the SGX543, it is immensely popular and is licensed
by a lot of companies for their products but there are 5 variants ranging
from single core to a model with sixteen cores. Have a look as to how much
their processing power differs when benchmarked at the same clock speed.

- (single core) 35M polygon/s @200 MHz
- (two cores) 68M polygon/s @200 MHz
- (four cores) 133M polygon/s @200 MHz
- (eight cores) 266M polygon/s @200 MHz
- (sixteen cores) 532M polygon/s @200 MHz

The performance ratio between the low-end and high-end variant is a
good 500 million polygons per second. So if you that a certain smartphone
has the SGX543 it may not necessarily have the 16 core variant. We do not
have such benchmarks for every variant of every GPU, so consider these
benchmarks purely as a reference.

The lack of cross-platform benchmarking tools is a pain in the sense
that you cannot properly compare two devices having different OS against
each other. There are plenty of cross platform browser benchmark tools,
then again these won’t paint the true picture at all. We have decided to used
proceed with a tool that is available on all three major platforms - GFXBench.
Now all of these benchmarks are offscreen benchmarks. By offscreen, we
mean that if these GPUs were pitted against each other on a level playing
field. In this set of benchmarks, we normalise all display sizes to a 1080p
display and have the GPU perform the benchmark for that resolution (1920
x 1080). If you wish to see how different smartphones/tablets compare
against each other then you have to consider the onscreen benchmarks.

Since more and more old PC games are being ported to the smartphone/
tablet platform (although not officially), we are pretty sure some of you
might be interested to see how SoC GPUs perform against mainstream
desktop GPUs, Anandtech has done a wonderful article on the very subject.

http://dgit.in/14loF2K
When it comes to performance parameters, we always seem to care most about the CPU and GPU. The other components play an equal role too.

**Battery**

Mobile phone and tablet batteries have come a long way since their inception. From being the bulk of the mass of an ordinary phone back in the 90’s to being one of the lightest components these days. However, phones have become slimmer, lighter and even now the battery can be said to be roughly half the phone’s weight.

In the early days a phone had to be recharged every 12-16 hours and now we hear of a battery that can last a month. This is a bit ambiguous as usage plays a huge factor in the life of a battery. With the advent of smartphones running heavy duty processors the current consumption has gone up again to
the point that you need to charge your phone once every other day.

**Battery types**
There are several types of batteries in use today like NiMH (Nickel Metal-hydride), NiCd (Nickel Cadmium) but the most popular would be the Li-ion (Lithium Ion) battery. It pretty much comes down to the manufacturer as NiMH and NiCd are cheap but they require frequent recharging and don’t hold as much charge as LiPo(Lithium Polymer) or Li-ion. These have been proven to hold enormous amount of electric charge while reducing recharge time. In the last two years itself, companies have come up with more different types of batteries than in the past decade. However, it will be some time before we get to see these enter mainstream usage. Batteries are manufactured according to their usage conditions and a battery that works efficiently in a car may not perform at par in another form factor.

**Battery rating**
When you flip your mobile battery, you’re bound to see a few figures here and there. These figures include certification emblems, safety standards applicable and most importantly the battery type, voltage rating and the battery capacity. A battery is called so, as it contains multiple cells, each of which is capable of carrying a certain charge of its own. However, this is very little for general use and thus multiple cells are combined in series/parallel to increase the voltage as well as current capacity.

The voltage rating simply gives the potential difference between the two terminals of the battery. This is pretty much fixed depending upon the type of chemicals used in the construction of the battery. For Li-ion batteries it can be 3.6v, 3.7v or 3.2v. Charge rating is shown using the unit mAh (milliAmpere-hour). One ampere-hour is equal to 3600 coulombs. Batteries are rated by these two parameters, i.e. voltage and current capacity (mAh).

The battery life or capacity can be calculated from the input current rating of the battery and the load current of the circuit. Battery life will be high when the load current is less and vice versa.

The battery capacity will be mentioned on the battery jacket but the load current being a variable is difficult to figure out. Since it depends on a
multitude of factors like the types of components powered on at the moment, each of which consumes a bit of charge. The battery life mentioned on the product packaging cannot really be used to compare one phone to another properly, sure it can give an approximation but since different manufacturers use different methodologies to test the battery life, there exists no standard. Some might test conservatively by just inserting one SIM and not using the phone at all. Others might switch on GPRS, Wi-Fi and Bluetooth and test. Obviously, the latter will show less battery life but on a standard testing scale this may not be the case at all.

**Battery care**

Good care must be taken to ensure that a battery lasts a long life, this includes paying attention to it’s charging cycles, the temperature, using the proper charger, etc. Here are a few pointers you need to keep in mind.

Your Li-ion battery has a limited number of charge cycles, as time progresses the capacity of the battery is going to reduce by a little bit till the point that you cannot afford to unplug the charger from your phone at all. Also, you really shouldn’t be using a phone while it is charging, they tend to get pretty hot and you risk being one of those lucky few whose phone blows up during use. An average Li-ion battery lasts about 1200 charge cycles. For example, if there are 365 days in a year and let’s say you charge 300 times a year, your battery should last 4 years before needing a replacement provided you take care of your battery.

Li-ion batteries also suffer from what is termed as the memory effect. When a battery is charged after having only been partially discharged, it sort of “remembers” the partial capacity, so the battery will show that it is fully charged when it actually is not. Given the cut-off mechanism in phones these days, when a battery tells that it is full the phone stops the charging, thus as your battery progresses through its charging cycles, your battery life reduces by a small amount each time. This is why you should always discharge your phone as much as possible before commencing another charge cycle (i.e plugging the charger in). It was claimed that Li-ion batteries do not suffer from the memory effect, however, recent studies have shown that they do suffer from the memory effect but not to the extent that NiMH and NiCd batteries do.

Use as few of your phone’s features as necessary to reduce consumption. Switch off Bluetooth, WiFi, 3G when not needed. Smart phones these days come with a quick menu wherein these features can be managed without
much fuss. Adjust the screen brightness to a level that is easy on the eyes and at the same time lower than half the screen's brightness to ensure a long discharge cycle.

An important factor to consider for phones slightly older would be to use the proper charger that came with it, as the amperage of the current inflow may cause the battery to bloat if it is higher than what the battery was designed to handle. Nowadays phones use USB to charge so any compatible outlet should do fine but stay away from cheap chargers as they might not be up to standard and could cause some damage to your device.

Here is a good article on taking care of your battery - http://digit.in/Battlast

**Display technology**

Display technology has progressed from the days of miniature screens whose sole purpose was to display the phone number and the name of the caller. Displays these days are pretty much miniature television screens capable of playing full HD 1080p signal. There isn’t much to differentiate between the technology that lies in your TV from that in your phone. Some screens are difficult to manufacture on a scale fit for television, that’s all.

Let’s have a look at the common tech behind your phone displays and a little insight into which is better in terms of viewing experience and energy efficiency.

**TFT-LCD**

The predecessor to all displays in the market, TFT-LCD (often termed simply as LCD) are by far the most used display tech, simply because there are a lot of manufacturers offering these and it thus has a good competitive economy about it. If your phone is a mid-range model then most probably it has this type of display but even the high-end Nexus 7 has this display.

TFT-LCD stands for Thin-Film Transistor Liquid Crystal Display and there are many different ways of manufacturing these screens, so just by calling it a TFT wouldn’t be of much help to you. Just like in desktop display where VA, TN and IPS, even mobile devices have a lot of different technologies. Thus, they show the same characteristics as desktop displays, i.e. varied colour reproduction, washed out colours at extreme viewing angles etc.

The drawback about TFT displays are that they are pretty thick and are the major contributing factor to the device’s thickness, the other being
the battery of course. High quality LCD screens will have bright, accurate colours and with visibility from just about any angle.

**AMOLED**

AMOLED (Active-matrix organic light-emitting diode) is a screen technology based on organic compounds that offers remarkably better image quality along with potentially very low power usage.

Till OLED screens came into the picture, all display technologies needed a backlight. This was the reason for their thickness, and each pixel would only control the colour shade. This also meant that the backlight would remain on and this 100% of the screen would be on. Unlike LCD screens, AMOLED displays don't need a backlight – each pixel produces its own light – so phones using them can potentially be thinner. Also, since each pixel can be turned off on its own this mean that certain portions of the screen which would be displaying black colour could be turned off completely, this is what most people term as true black, i.e. absence of any light.

It also means that a mostly black screen will use very little electricity, and the colour reproduction is much better as opposed to TFT where dark regions would be reproduced as dark grey rather than true black.

This being said, AMOLED screens are rather expensive to produce in terms of cost and time, hence, you'll find these screens only in the upper mid-range and top-end products. Another drawback is that on a subpixel level, the arrangement of the subpixel is rather different as compared to LCD, thus there will be a slight distortion when compared to an LCD. High-end LCD screens which are found on certain top-end phones are capable of outdoing the colour reproduction capability of AMOLED screens.

**Super AMOLED**

An improvement over traditional AMOLED screens, Super AMOLED screens have superior brightness and colour reproduction. What is primarily different is that these screens have the capacitive touchscreen included in the manufacturing process and do not use a digitizer overlay as is the case in other screens.

**Super AMOLED Plus**

The subpixel arrangement of AMOLED screens led to a slightly distorted image being produced. With the advent of Super AMOLED Plus, this was fixed as the subpixel arrangement was modified to resemble that of an LCD, thus ensuring a cleaner image.
Super AMOLED HD
A step ahead and then a step back, Super AMOLED HD screens had higher resolution but it ended up going back to the subpixel arrangement of normal AMOLED screens. So essentially, the distortion in the image would be so negligible that most casual users wouldn’t notice it. So the expensive process of subpixel arrangement correction was ditched to make cheap, high-resolution images.

Retina display
When observed closely any display will show the individual pixels, but as you move away from the screen this individuality is less visible and you observe a cleaner image. So basically when you increase the pixel density (number of pixels per unit area) the distance at which pixelation is not apparent becomes lesser. So you can hold the screen closer to you still see a clean image. This is what Apple did, there was no new technology behind the retina display, at the end of the day it all came down to marketing mumbo jumbo. Most screens these days have similar or greater pixel density, so pretty much every display is a “retina” display.

Super-LCD
Super-LCD or SLCD is a TFT screen but with characteristics similar to an AMOLED screen, so there is better black colour reproduction which is comparable to that of AMOLED screens. It still has a backlight but is considerably power efficient as compared to the regular TFT screen.

Touchscreen - Capacitive or Resistive
Touchscreens are a vital component of smartphones these days, almost all major platforms have migrated to using touchscreens instead of keypads mostly because of the versatility that a touchscreen offers. Touchscreens are what recognizes where on the screen you’ve placed your finger or stylus and communicates the co-ordinates to the phone’s CPU accordingly.

There are two popular types of touchscreens available on devices these days, one is the resistive touchscreen and the other is the capacitive touchscreen. The resistive touchscreen has two layers (separated by a miniscule gap) which form an overlay over the screen. When a finger is placed on any point on the screen, the two form a contact and the co-ordinates are obtained. These are relatively cheap to make and are rightly found on most budget phones. The downside is that a certain amount of pressure is
required to register a touch so as time goes by some degree of damage does occur to the screen.

The other type is the capacitive touchscreen which has the entire screen coated with a capacitive substance which holds a certain amount of electrical charge; when a conducting object like a finger is placed on the screen, there is a change in capacitance on that point and thus the coordinates are obtained. Capacitive touchscreens don’t respond well in cold climates where the human finger doesn’t cause much change in capacitance, thus a stylus is recommended for such scenarios.

Then there are multi-touch touchscreens wherein almost all fingers can be pinpointed accurately. This has led to an increase in the number of gestures that one can perform on a touchscreen.

**Bluetooth**

Bluetooth is a protocol that allows data transfer between two devices over short distances. It’s ever-increasing popularity has led to a plethora of Bluetooth supported accessories for mobile devices, with hands-free headsets being the most popular.

While, manufacturers have come up with remarkable applications for this technology, however, most of them are being replicated using Wi-Fi. Though slightly more power consuming, Wi-Fi offers greater range and bandwidth, thus allowing faster and low latency access times. But this did not spell the end of Bluetooth as battery woes will never leave the smartphone and tablets alone in the near future, so a low power option like Bluetooth is a necessity. With Bluetooth
4.0 now appearing in most new devices, it now offers the similar range and bandwidth as that of Wi-Fi but with a lot less power consumption. Since Bluetooth is backwards compatible, your old accessories can be used with new devices without much issues, but you’d not be able to reap the benefits of the new features that each revision brings with it. Here is a simple table highlighting the differences between different Bluetooth versions.

**Wi-Fi**

Wi-Fi or IEEE 802.11 is an older protocol for data transfer but consumed much more power and offered higher range and bandwidth. Wi-Fi too has undergone multiple revisions with multiple improvements in each revision that led to a much efficient system for data transfer.

Wi-Fi can connect to a host of devices to interconnect and access the internet. This method of connection can require a mediator as in most centralised/decentralised/hybrid systems, however, there also exist methods to enable ad-hoc networks (simple closed group, even one-to-one) like Wi-Fi Direct.

The current revision of Wi-Fi is 802.11ac, however, the average user won’t be able to saturate anything above 802.11n. The current internet services simply don’t offer services that’d need more bandwidth than 802.11n. Then again since it uses a different frequency band there is less interference compared to existing radio technologies. It is the most common and widely used protocol, so anything above that is a luxury. The good thing about this is that it is comparatively power efficient and thus better suited for mobile application and each successive revision will be better.

Here is a simple table to compare existing Wi-Fi protocols:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Wi-Fi(a)</th>
<th>Wi-Fi(b)</th>
<th>Wi-Fi(g)</th>
<th>WiMAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (GHz)</td>
<td>5</td>
<td>2.4</td>
<td>2.4</td>
<td>802.16</td>
</tr>
<tr>
<td>Speed Mbps</td>
<td>54</td>
<td>11</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Range</td>
<td>50m</td>
<td>100m</td>
<td>100m</td>
<td>50km</td>
</tr>
<tr>
<td>Advantages</td>
<td>Speed</td>
<td>Low cost</td>
<td>Speed</td>
<td>Speed</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Cost</td>
<td>Speed</td>
<td>Cost, Range</td>
<td>Cost</td>
</tr>
<tr>
<td>Radio technology</td>
<td>OFDM</td>
<td>Direct sequence spread spectrum</td>
<td>OFDM(64-channels)</td>
<td>OFDM(256-channels)</td>
</tr>
<tr>
<td>Mobility</td>
<td>In development</td>
<td>In development</td>
<td>In development</td>
<td>Mobile WiMAX (802.16e)</td>
</tr>
<tr>
<td>Primary application</td>
<td>Wireless LAN</td>
<td>Wireless LAN</td>
<td>Wireless LAN</td>
<td>Broadband wireless access</td>
</tr>
</tbody>
</table>
Memory

Quite simply put memory is of two types, RAM (Random Access Memory) and ROM (Read Only Memory). Both of these are essential in the running of a computer, be it a mobile device or a full fledged desktop.

ROM is the permanent memory on phones it not only consists on memory chips/modules on the device as well as the extensible memory which is fulfilled by means of a memory card. Whereas RAM is purely onboard and is a volatile memory, volatile means that the memory does not retain data upon losing power. They are quite different from each other when it comes to the application of memory. ROM is where data like the applications, images, videos and pretty much everything is stored. The RAM is where data is stored temporarily which needs to be accessed more frequently. So if an application accesses a certain data file way too many times then it might be cached in the RAM to allow faster access, however, this isn’t the primary purpose for which RAM exists. Memory is organised in a hierarchy of memory where the fastest is at the top and the slowest at the bottom. The real fast memory are called registers and exist on the processors themselves and hold elements of mathematical equations and such low level data which is needed immediately. Then comes shared memory which allows multiple processors to share memory, after that comes RAM and then ROM.

However, RAM is not cheap compared to other modes of storage and it is volatile which is why not all forms of memory are made using RAM chips. However, Solid State Drives in computers are coming up with chips very similar to RAM but with less volatility which allows for really fast data transfer.

How much RAM do you need?

Most applications these days are fine with mobile devices that have 1 Giga-byte of RAM. However, if past trends are to be studied, more and more applications will soon follow which will need much more RAM. It really comes down to the programmer, if the application uses a lot of elements which constantly change then that much more RAM is needed, otherwise the programmer can make do with ROM. The downside of this approach is that the application becomes slow to the point that casual users can feel the sluggishness of whatever application is under use currently. This does not imply that any sluggish interface is purely due to lack of RAM, there are a lot more factors that come into play here.
On devices that allow multitasking, even more RAM is needed as each active task will take up a certain amount of memory and cumulatively this would exceed what is available at hand. Worry not! For in such cases there are memory management functions part of the phones operating system which constantly dump or delete what all is currently not needed. So a background application may have its contents dropped from the RAM to make way for the active application. On devices which don’t allow multitasking, the RAM needed is much less since there would only be one application running at any given time. While most of you might think that the word “application” refers to just any app that you’d download from the app store or Google play, this actually refers to any subcomponent of the operating system as well. For example, if you have five widgets enabled on your homescreen, each of that will consume a certain amount of RAM always. Switching of the Wi-Fi or Bluetooth will take up a portion of the RAM. Everything needs RAM to run, which is why it is a very precious resource.

If you find that after some time your phone has turned a bit sluggish then mostly it has a lot of background process which are eating up the RAM. Removing these or disabling them should alleviate your RAM woes. So in a nutshell, the more applications you are going to be using, the more RAM you’ll need. Anything around 1 gigabyte is plenty for the average user.

**Extra memory?**

By extra memory we do not mean RAM, it’s the extensible memory we are now talking about. The majority of devices in the market come with around 8-16 gigabytes of ROM. While this is enough for some users to host around 60 applications and a few hundred songs and images, the need for more has always existed. Which is why SD cards exist, they might have been limited to the domain of digital cameras in the past but now the usage in smartphones and tablets outnumbers that of cameras by a huge extent.
SD cards are very popular but are slightly bulky in an age where everything is progressing to a smaller form factor. This led to the introduction of microSD cards which are less than a quarter the size and much thinner. Capacities range from 1GB to 64GB currently, though a 16GB card is more favourable in most aspects including price and storage space. However, if you are intent on carrying your entire music library with you all the time then invest in more memory accordingly. Though, it’d be prudent to remember that almost all devices only come with one slot for extensible memory. Also the letters SD may be succeeded by either HC (High Capacity) or XC (Extended Capacity), this relates to the capacity of the memory and nothing else. Cards between 4-32GB are labelled SDHC and those above 32GB are labelled SDXC, this has nothing to do with quality or speed. Before purchasing a memory card do find out what is the maximum that your smartphone or tablet can support, buying more than the supported amount would not necessarily work or even if it does then expect glitches.

Memory cards are graded according to their data transfer speed or class as it is called in this case. The lower class memory cards are cheaper but not by a huge margin. The following table shows the different memory classes and their respective speeds.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>MINIMUM PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2</td>
<td>2 MByte/sec</td>
</tr>
<tr>
<td>Class 4</td>
<td>4 MByte/sec</td>
</tr>
<tr>
<td>Class 6</td>
<td>6 MByte/sec</td>
</tr>
<tr>
<td>Class 10</td>
<td>10 MByte/sec</td>
</tr>
</tbody>
</table>

**Near field communication**

NFC is a relatively new technology that allows communication over very small distances. Currently only found on high-end phones NFC is slowly gaining popularity. More and more applications are discovered with each passing moment.

NFC is very similar to the way that RFID works, communication can be accomplished between two actively powered devices or between one active and one passive device. The first scenario is where we have two NFC devices brought close together while the latter deals with a NFC tag being swiped over a NFC device or vice versa. The technology consumes next to zero power since the transmission distance very short (often a few centimeters) for active to active communication but when a passive element is to be read, then it has to be “illuminated” (powered
which does consume a bit of power. This brings the NFC pretty close to Bluetooth 4.0 VL in terms of energy efficiency.

There is no pairing code in this scenario as is present in Bluetooth, so security concerns regarding what data should be present on an NFC chip have been raised. Across the world there are pilot programmes being conducted to test the feasibility of this new technology. As for India, there hasn’t been anything so far, basically due to poor penetration of the technology, so NFC is mostly used here for contact swapping. The applications are pretty diverse, we now have mobile phones acting as wallets which can be used at shopping malls, to pay public transport ticket fares, utilise parking meters, etc. Then we have interactive advertising posters which can import your details to present you with customised offers and so on. The primary application scenario is to eliminate plastic credit/debit cards which as we all know is pretty sensitive to magnets and scratches on the magnetic strip can wreak havoc.

GPS

GPS is one of the many global navigation systems based on satellites in space. It is used to pinpoint your current position accurately within a few meters. There are applications to help you navigate from one place to another, then there are applications which track your locations and the places you visit to generate social profiles, etc.

GPS requires that your device to establish communication with at least three satellites for a geographical location and a further 4th for altitude and error correction. It’s quite a handy feature for tourists to navigate foreign countries and locations outside terrestrial transmission equipment’s coverage.

SIM sizes

With the ever increasing drive to shrink things even the SIM card had to undergo shrinkage. We now have three variants -
- Mini-SIM
- Micro-SIM
- Nano-SIM

This does not mean that you’d have to get a new SIM when you buy your next mobile or tablet. There are special mechanical punch machines which can convert your Mini-SIM to a
Micro-SIM. However, punching the same to get a Nano-SIM is not advised as the shearing can cause damage to the SIM card. Also, the thickness of a Nano-SIM is 15% lesser compared to its predecessors so it’s best to contact your service provider and get a new SIM. There are adapters available to use your Micro-SIM in a Mini-SIM phone, or you could save the punched plastic as an adapter as well.

**Radio+RDS**

Radio is something that has survived quite a lot and still exists in most mobile phones and tablets. Since the technology has remained unchanged for decades there isn’t much new however, phones do come with RDS these days. RDS stands for Radio Data System, it is a protocol by means of which the radio station can embed bits of information along with the regular transmission.

There are predefined fields which can be transmitted, each field pertains to a certain context. All of this is text based communication. Common fields include:

**AF (alternative frequencies)**
If the current FM signal becomes too weak then the receiver can obtain an alternate channel by reading this field and switch to that to get better reception.

**CT (clock time)**
This field gives the current time as transmitted by the radio station.

**EON (enhanced other networks)**
This allows the receiver to check other stations mainly for traffic updates.

**PI (programme identification)**
This field identifies a particular station with the country of origin.

**PS (programme service)**
On most occasions the only way to identify a Radio station is by identifying the radio jockey or wait for the station’s unique chime. With the PS field the station can transmit 8 characters to identify itself.

**PTY (programme type)**
There are 31 predefined program types, using this field the station can
identify the current program type. Also, certain radios are programmed to listen for PTY31 which is the emergency broadcast program type.

REG (regional)
This field identifies the region of the transmission. In places where transmissions in multiple languages occur or if it is a region close to a national/state border, this can be used to lock onto a certain set of transmissions. Thus it helps in weeding out unwanted transmission stations.

RT (radio text)
This 64 character field can be used to send anything pertaining to the current radio station which the user is listening to. It can be the song title, author or even emergency numbers in case of natural disasters.

Smartphone cameras
Plenty of folks are tired of having to carry a bunch of electronic devices wherever they go. This is not specific to the older generation or the newer generation. The need for a device that “does it all” has been the driving force for innovations like the simple wired phone becoming wireless, having a radio built in, doubling up as a music player and as a camera. Heck we now have high-end phones with cameras that boast of having 16 Megapixel sensors. This is more than most budget point-and-shoot cameras boast of in the market.

So what is it that you need to know about these cameras? They obviously don’t have all the features that cameras have, which would allow
you to customise shots but they do have enough to satiate the needs of the average joe. Cameras are primarily judged on their sensors, on which the quality of the image is dependant. Now manufacturers do have some tricks up their sleeves, for example, a manufacturer may claim that a certain phone has the ability to take 8 megapixel images, but this might not mean that the phone has an 8 megapixel sensor. Instead, the scene which is being photographed is broken down into pieces of say 2 megapixel resolution. This way the scene is divided into 4 parts and the 2 megapixel sensor takes 4 photos and then combines them to give you an eight megapixel image. Not that most people would be able to notice the difference, but in case you are going in for a phone with the camera being a priority then it is something that you need to keep in mind. Also, most phones these days to have two cameras, one in the front facing the user and the other on the back. The front facing camera is used for video chatting primarily and the rear facing camera is for everything else that you could do with a camera. You need not worry much about the native photo editing capabilities of your phone or tablet as there are plenty of applications available to do the same.

As far as the camera flash is concerned there are primarily two types:

- LED
- XENON

The LED flash is what’s present on almost all phone in the budget and mid-range categories. It’s not bright but that helps save a lot of power and subsequently you can get a lot more shots from your phone, you’d even run out of space on your memory card before the phone battery runs out. The XENON flash is what you need if you want images to be more lifelike and not washed out. This is because the colour temperature of a XENON flash is closer to the colour temperature of sunlight, which means your photos seem closer to what you’d get from a proper camera. XENON flashes consume a lot more power and thus require charging up, i.e. they have a capacitor hooked up to them. So the time gap between two consecutive shots is determined by the time taken to charge up the capacitor, which means you don’t have the luxury of taking rapid fire shots which is possible even with the cheapest point and shoot. However, a new patent awarded to Google could see things change as they’ve proposed an array of flashes. Not only can each individual flash charge up and fire independently, but with the combination of all flashes you can come up with varying intensities of brightness.
Sensors
There are a multitude of sensors in smart phones these days which has made the device even more versatile. There are light sensors, barometers, hygrometers, compass to name a few. Let’s have a detailed look at this.

ALS
An ambient light sensor makes use of two different types of photodiodes (or light sensors) to each record the level of light currently falling on the screen. By combining the output of these two sensors portable devices such as tablets, smartphones, and laptops can sense a side pectrum of light. Thus it can accurately measure the brightness of the room. This information is then used to adjust the screen brightness to make it easier on the user’s eyes and also helps to extend battery life.

Proximity Sensor
A proximity sensor detects how close a smartphone is to your body thus letting the smartphone know whether you have the screen close to your cheek. In order to save battery life and also to prevent accidental touchscreen input the phone automatically switches these things off. Thus the user can take a call by just placing the phone on their cheek, there is no need to do anything else. All current tasks will be saved and the display switched off for the duration of the call.

Accelerometer
An accelerometer is what reads the acceleration of the device along three axes - X, Y and Z. So when you tilt your phone or flick your phone to change a radio station or skip a song, it is the accelerometer which senses this and performs the appropriate action. These are very sensitive devices which can measure acceleration up to 1G on a fine scale.

Compass
The compass is simply used to figure out the magnetic north and relay the information. However, most electronic circuits these days do not use magnets but instead they rely on the change in a magnetic field around a flow of current to figure out the direction. This is why your compass application demands a calibration each time it is activated. Without the compass sensor your phone will not be able to provide you with directions even if you have the application installed.
Gyroscope
A gyroscope is a sensor which can sense the current orientation of the device. So when you slowly tilt your phone or tablet, it is the gyroscope which tells how the device is oriented. Basically when you switch on screen rotation, it is the gyroscope which helps the screen rotate and orient itself in the proper manner. Also, racing games which allow you to use the device as a steering wheel uses the gyroscope to guide the car.

So what’s next?
Recently devices have started featuring thermometers (temperature), barometers (pressure) and hygrometers (humidity). This can be utilised in some creative ways, devices can be powered off if it gets too hot or too wet for proper functioning. Imagine your device with very sensitive information caught up in a fire, it could detect the impending doom and transmit all data to a backup server before going up in smoke!
MOBILE AND TABLET SOFTWARE

The most successful devices are those that are able to marry the hardware and software to work as one. How? Read on to find out.

Now that we’ve discussed the hardware that goes inside a mobile and a tablet, let us now discuss the software that runs on these devices. This section will detail the operating systems and application ecosystems associated with them along with the customisation options available for various devices.

Operating Systems
Mobile operating systems like their stationary, table-top counterparts are primarily responsible for efficiently managing the resources available and delivering a smooth user experience at the same time. The only catch as far as mobile OSes are concerned is that, these calculations must be power-aware. The battery which powers the huge high-definition screens, cellular radio, WiFi, BlueTooth, Camera, GPS navigation, speech recognition et al.
on such devices is limited in it’s capacity. Thus it’s onus on the operating
system to make sure that the power is optimally utilized among all the
hardware and applications.

**iOS**

Albeit not the first smartphone OS to hit the market, it certainly is respon-
sible for piquing everyone’s fancy and opening the floodgates with it’s sleek
and stylish UI. Originally presented as OS X for iPhone when it released in
2007, iOS is essentially a mobile version of OS X. It uses the ARM-variant
of OS X’s foundation – Darwin, which itself is built using XNU, a hybrid
kernel which combines the Mach microkernel, elements of BSD and an
object-oriented device driver API. It also shares a couple of application
frameworks like Cocoa which powers the touch layer in iOS.

Applications for iOS are written in
Objective-C. They interact with the oper-
ating system through abstraction layers –
_Core OS Layer, responsible for the low level
features it’s not made available to the devel-
oper directly but the other layers are built
on top of this layer; Core Services Layer
which provides all the fundamental system
services that nearly all the applications use;
Media Layer is responsible for handling
graphics, video and audio subsystems and
the Cocoa Touch Layer which is the front-
facing component of the entire architecture
responsible for managing multitasking,
touch-based input, push notifications and
other high-level system services. Apple
provides developers with XCode and iOS
SDK. The SDK exposes these layers to the
developers which allow them to optimally access the system functionality.
The current stable version of the operating system is 6.1.4. The next version
which was previewed in WWDC 2013, iOS 7 is a major system overhaul
which will be made available this fall.

iOS currently runs on iPhone, iPod Touch, iPad and Apple TV. Unlike
the other systems that we’ll discuss Apple doesn’t allow the system to run
on 3rd party hardware. This makes sure that Apple is in full control of the
hardware on which it’s operating system runs which guarantees excellent system performance. Apple also supports the devices over a long duration, in case of an OS update an older device may get a subset of all the upgrades due to the hardware limitations but it still does get the update irrespective of operator.

**Android**

Android doesn’t warrant any introduction. This mobile operating system wunderkind brings together the best of open source and proprietary, closed source software from Google to provide a brilliant platform which continues to revolutionize the mobile industry with nearly 1.5 million device activated everyday. Android constitutes of a kernel based on Linux kernel version 3.x (Android 4.0 Ice Cream Sandwich onwards) or version 2.6 (earlier versions of Android), middleware, libraries and APIs written in C. Android doesn’t behave like a traditional Linux system as it doesn’t support X Window System and comes without a lot of standard GNU libraries, so in strictest of terms it is not Linux. Android runs on ARM, x86, MIPS and Freescale’s i.MX.

The applications run on an application framework which includes libraries based on Apache Harmony, Apache’s open source Java implementation. It uses the Dalvik virtual machine with JIT (just in time) compilation to run Dalvik ‘dex-code’. The apps are written in Java which are converted to bytecode and then translated to Dalvik ‘dex-code’ for optimized execution. Dalvik was chosen over the official JVM because it operates better in an embedded environment with improved CPU utilization and minimum memory usage. The Dalvik VM supports a standard set of core Java APIs. The current stable version of the OS is Android 4.2 Jelly Bean.

Android is used a host of devices from a host of manufacturers across the world, making it impossible to list all the devices that can run Android here. Hardware and Android have always been at odds, the huge disparity in hardware among devices opens a new can of worms, as all of them have to run a different version of the software. Each new update must be specifically tailored to that device and must be made available by the manufacturer. A
Mobile and tablet software build of vanilla source code will work only on Google's Nexus branded devices, the other manufactures and operators will have to provide a binary image specific to their device. Due to this a lot of devices remain with older, clunkier versions of the operating systems and only the high-end phones getting regular updates.

**BlackBerry**

Usually associated with suits and serious work, we’ll be talking about BlackBerry’s (formerly RIM) all-out effort to reinvent itself with its fresh out of oven operating system, BlackBerry 10. It is build using the QNX Neutrino RTOS as its foundation while the user interface is powered by the Qt-based Cascades Native User-Interface framework. The QNX Neutrino is a microkernel-based OS which implements the core POSIX features. At its lowest level, the microkernel contains a few fundamental objects and the highly optimized routines that manipulate these objects. The microkernel is itself entirely written in C.

As the OS is POSIX con- formant the applications can be written in C/C++ itself and then utilizing the various services provided by the middleware and other libraries. BlackBerry also provides a QNX Momentics Tool Suite which is an end-to-end solution for development on QNX-based systems. Another very intelligent additions to the application development suite are - BlackBerry WebWorks and Runtime for Android Apps. With BlackBerry WebWorks, traditional web applications written in HTML5/CSS3/JavaScript can be repackaged to become the first-class apps on a BlackBerry 10 device. Runtime for Android Apps on the other hand, allows developers to run Android Jelly Bean 4.2.2 (10.2 beta) platform applications on the BlackBerry 10 OS.
Currently only two handset from BlackBerry, the Z10 and Q10 run BlackBerry 10. Like iOS BlackBerry is in full control of the hardware and hence the touch performance and system responsiveness are excellent, with the added benefits of having a microkernel at the core which enhances application performance and security. Device support may be an issue here, with the new release BlackBerry broke compatibility with it’s older lineup, though another OS revamp is nowhere near in sight.

**Windows Phone**
The Redmond-based PC giant's mobile OS offerings come in two flavours - Windows Phone 7 for the smartphones in the lower price range with medium specifications and Windows Phone 8 for the costlier, high-end smartphones. Windows Phone 8 uses a Windows NT kernel as opposed to the Windows CE-based architectures which was seen in the previous
Mobile and tablet software version. The new kernel shares many components with Windows 8, so that applications can be easily ported between the two platforms. The new NT kernel adds support for multi-core CPUs of up to 64 cores, larger displays till 1280x768 resolution along with a lot of other hardware support like support for MicroSD cards.

Windows Phone 7 applications use XNA (a WP7 specific version of Silverlight) while Windows Phone 8 will support running of managed code through the Common Language Runtime similar to Windows 8 as opposed to the .NET Compact Framework used in the previous version. Windows Phone 8 also supports native C and C++ libraries and by extension allows the apps to be written in native languages. This OS is exclusive to smartphones, the tablets run either the fully-featured Windows 8 or a somewhat stunted Windows RT.

Windows Phone 7 devices are being produced by LG, Samsung, HTC, Dell, Acer, Alcatel and ZTE, Nokia. Windows Phone 8 devices are currently being produced by Nokia, HTC, and Samsung. Microsoft places stringent requirement on manufacturers for it’s operating system with only the older Windows Phone 7 supporting slower processors and memory. This ensures that all devices in the same price range perform equally well. Microsoft will support Windows Phone 7 till September 2014.

Other OSes
There are a couple of other operating systems which are usually released with much pomp and pageantry in PR blitzkrieg but they usually fade to ignominy when faced with the unrelenting Android juggernaut. Symbian is one such example, championed by Nokia it was the most used smartphone operating system till 2010 when Android caught up. Nokia has now outsourced the maintenance of the OS to Accenture, which has vowed to support it till 2016. Nokia PureView 808 was the last Symbian phone to hit the market. Bada is another such operating system, it was being developed by Samsung to be used in the low-end feature phones but it has stopped it’s development and moved the development team to Tizen, another open source mobile operating system. Jolla and webOS are...
other such systems which failed to take off. Only 64 million units were sold in 2006, when Android, iOS, Windows Phone didn’t even exist on paper. Based on Gartner’s calculations about 2 billion smartphones have been sold till the end of the first quarter of 2013. The top mobile operating systems by market share are Android, Apple iOS, BlackBerry, Windows Phone, Symbian and Bada.

**Upcoming platforms**

There are couple of operating systems which are in the pipeline and look quite promising. One of them is Aliyun OS, from Alibaba.com, it is a cloud-based operating system which will provide the usual service that a smartphone accords, the only difference being that the applications will be served from the cloud which would allow users to access applications from the Web, rather than download apps to their devices. Firefox OS also known as B2G (Boot2Gecko) uses the standard open web stack to power it’s operating system with foundations in Android. A lot of manufacturers and operators have come together with the Linux Foundation to come up with a new oper-
ating system which uses MeeGo and LiMo as it’s base. And last but not
the least the Ubuntu Touch OS, from Canonical with a brilliant new take
on mobile operating systems.

**App Ecosystems**
The most important aspect of any mobile operating systems success is the
health and robustness of it’s app ecosystems. The amount of third-party
apps available to the user have played a very important part in deciding the
fates of many a platforms, Apple and Google’s success in a large measure
can be attributed to their excellent app ecosystem powered by Google Play
and iTunes. We’ll be discussing the four major digital distribution platforms
for all the major operating systems that we discussed earlier: Google Play
for Android, App Store for iOS, BlackBerry World for BlackBerry and the
Windows Phone Store for Windows Phone.

According to Canalys, the app downloads for all the four stores combined,
reached a total of 13.4 billion in the first quarter of 2013. Without considering
revenue sharing these stores combined raked in a whopping $2.2 billion.
Apple’s App Store has taken the lead as far as revenue is concerned, with
the largest proportion of revenue at around 74%. Google Play on the other
hand saw the largest amount of downloads with it accounting for nearly
51% of the collective downloads total. Windows Phone Store and BlackBerry
World are distant challengers to these two heavyweights and will require
a lot of effort to entice developers and add innovative content and services
to their application catalog.

**Google Play**
Originally known as Android Marketplace, it was rebranded as Google
Play so that it better aligns with Google’s take on digital distribution for
music, movies & tv shows, magazine and books in addition to Android
applications. It currently has the largest catalog of apps on the planet with
about 8,50,000 apps and about 48 billion app downloads till May 2013. One
thing to note is that the Google Play application is not open source, only the
devices that comply with Google’s compatibility requirements may install
and access this application.

Another thing to note is that the user is not limited to Play Store alone
to get the apps, they can be downloaded from the developer’s website or
even another android application store. Google Play store is often derided
for the lack of quality of applications in the app store and there are often
complains of malwares making a way into the store. Google has introduced a lot of safeguards into the system particularly with the introduction of Google Bouncer which has led to a marked decrease in the amount malware submissions. Android 4.2 Jelly Bean also features an app scanner built into the system which notifies the user of any malicious activities.

**Apple App Store**

Apple pioneered digital content distribution with iTunes, during the iPod-era. They extended it to the then newly launched iPhone through the App Store. The App Store as of June 2013, boasts of about 9,00,000 apps with the total download count crossing 50 billion. An average application is usually downloaded about 5000 times. You can download the apps either directly
to your device or to your iTunes where the application(s) will be transferred on the next sync. One of the most interesting aspect of the App Store is that, a lot of applications are also available for iPad. According to the last count nearly 3,50,000 applications are available for the iPad.

The ecosystem is under a tight control of Apple’s iron-fists, App Store is the only official way of getting applications for your iDevice. You can sideload apps onto the device but you’ll have to jailbreak your device first to be able to do that. The iOS ecosystem is also the most profitable of all the other distribution systems. The latest report by Distimo, an App analytics firm show that in April, the App Store generated $5.1 million in sales per day for the top 200 grossing apps when compared to Google Play’s revenue $1.1 million.

**Windows Phone Store**

Microsoft’s app distribution service for its mobile offerings focuses exclusively on apps and games. According to the last count released by the company there are total of 1,45,000 apps available for download through the Windows Phone Store, it has overshot BlackBerry world a long time back. Another added benefit of having a Windows Phone is Xbox Live
integration. If an Xbox live account is enabled, the store can be accessed remotely from the phone itself. Microsoft has launched a sizeable amount of premium games with Xbox Live integration which lets you enjoy and share the games with your friends on Xbox live.

Like iOS and App Store, the Windows Phone Store is the only way to officially download the apps. There are a few ways to sideload apps but they’re too cumbersome for the average user, adding to the fact that the developer/hacker community for Windows Phone is not as active for the other operating systems.

**BlackBerry World**

BlackBerry’s digital distribution platform for its entire product lineup, the name was changed from BlackBerry App World to a simpler BlackBerry World to mark the release of BlackBerry 10. BlackBerry World currently has about 1,20,000 applications which include both native and ported Android applications. It is a brilliant feat that this platform has accomplished where is added 20,000 applications in less than two months.

One problem that still plagues this platform is the quality of app submission. More than 20% of the applications have been ported from Android, while a lot of other apps are web apps which tend to be of a lower quality. BlackBerry 10 only offers 34% of the most popular apps found on Android and iOS. Infact favourite applications like Instagram are still not to be found on BlackBerry World.
If the Pareto Law holds true for the applications too, then it may be the case that you are using 20% of the apps 80% of the time. In this case the “app gap” between the platforms becomes irrelevant. There is no one true way to measure this disparity in the apps provided as there are a number of factors under consideration - each platform has its own conditions, requirements, APIs and app store. When deciding on a particular mobile platform it is important to take the app ecosystem into consideration. But the decision on whether a platform is good enough for you is entirely yours. You’ll have to figure out the apps that you use regularly and go through the app stores, in this case you’ll find that your opinion is the only one that counts.

**Customisability**

The latest generation of devices that we’re seeing right now are extremely powerful with excellent specs but the power goes largely untapped due to the restrictions placed by the device manufacturers, carriers and the stock versions of the operating systems. By customisation we mean loading a customized operating system image which will put you in the driver seat and allow you to fully utilize your device’s capabilities.

Android phones hands down is the most customisable OS. The very first step when installing a custom ROM is unlocking your bootloader. With the recent softening in stance by operators and manufacturers, you’re officially able to unlock your bootloader (you waive your warranty though). If you’re not able to officially unlock it, particularly on older phones you have multitude of options available like the SuperOneClick unlocker and so on which will allow you to unlock your device. Installing a custom ROM is then only the question of flashing a
new image onto the ROM. You can also install custom kernels which lower CPU voltages and save power. Custom ROMs and rooting also allows you to overclock your processor in case you want to eek out the maximum performance from your CPU. XDA Developers is an excellent forum where you’ll get a host of resource for rooting and customizing your device.

iOS devices are a different story, you need to jailbreak the phone and unlock the bootloader which will allow you to install custom images. You can install a different version of iOS or a different OS altogether. For eg. iDroid for running Android on your iDevice. It is based on Bootrom exploits which allowing the running of unsigned code at low level.

There has been a huge progress in the bootloader unlockers and custom ROMs for Windows Phone devices in the last couple of months. XDA threads are a flood with custom ROMs for Windows Phone 7.8 along with unlocked bootloaders and custom ROMs for high-end smartphones like HTC Titan and Radar. You’ll find a lot of details over at WPCentral (http://www.wpcentral.com/tags/custom-roms) which keeps a close eye on the happenings in this area.

We did a huge section in last month’s (June 2013) Tips and Tricks called ‘Hack your Smartphone’ which detailed a lot of methods by which you can root/jailbreak your device to load a custom image of the operating system. It’s an excellent place to get started, it also has links in the post-rooting section which describe in detail how to install custom ROM images for each of the above mentioned platform. Please note that the instructions mentioned in the article for rooting smartphones hold true for tablets as well. 

CyanogenMod
The functionality of your portable device can be greatly increased using after-market accessories. These hardware knickknacks are definitely worthy of your attention.

So you’ve bought a new smartphone or tablet or phablet, it doesn’t matter whether it’s a budget phone or the top of the line model currently available, proper care must always be taken for your phone. Also, plunking down thousands upon thousands of rupees for a great phone and then using almost crappy accessories does not do justice to your initial investment. It’s almost to the point that these essential accessories are now being bundled along with the phone in the packaging or the re-seller might do it to garner more sales. This doesn’t mean that you
might be getting the best deal for your moolah. You might have to invest a bit more to ensure a better experience. Here are some accessories that we believe are absolutely essential for your new phone.

**Screenguard**

A screenguard is a thin sheet of protective material which you’d attach to the screen to protect it from superficial damage or to maintain privacy. They come in all shapes and sizes and are made of a variety of materials. There are usually made out of plastic, sometimes even flexible glass. They are usually formed by combining thin layers of plastic and glass placed in an alternate fashion. Prolonged use of a touchscreen can lead to a lot of micro-scratches being etched into the screen which, overtime, will lead to a cloudy appearance and subsequently loss of sensitivity to touch. However, if you end up buying a super thin cheap screenguard that you get on the local trains/novelty stores then it’d be as good as not buying one in the first place since they are just plastic tape. A good screenguard is hard and fits your screen properly. You have a lot of choice regarding what kind of screenguard you wish to buy, here are some commonly available ones.

- **Glossy finish**
  The most common variety available, you’ll hardly notice that you have one on.

- **Transient filter**
  If you don’t like others peeking onto your screen then this is the one for you. They are also known as privacy filters.

- **Mirror coating**
  Another privacy filter, these screenguards can double up as a small mirror once the screen is switched off, however, the mirror finish does make it difficult to view the screen in broad daylight.

- **Anti-glare coating**
  Quite the opposite of a mirror coat, these will ensure that you can proper visibility of the entire screen area even if there are a lot of reflective light sources around you.
Essential Mobile and Tablet Accessories

- Oleophobic coating
  As the name says, these work great at keeping fingerprints at bay.

- UV filter
  Anything kept in the sun undergoes damage overtime, these screen-guards filter out the damage causing UV rays and protect your screen.

- Matte surface
  If you prefer a matte finish for your screen rather than the stock glossy finish then this is something that you’d like.

Silicon Cover
For Mr. Butterfingers out there, this would be a prudent purchase. Silicone covers do tend to spoil the look of your phone but that would be preferable considering that dropping the phone sans the silicone cover might leave you without a phone altogether. It’s a good option for the folks who prefer the extra bulk and the texture of the silicone cover helps prevent loss due to pickpocketing. Besides this, if you like to give your phone some personality then there are a lot of vanity cases available.

Bluetooth headset
You never know when you need to answer a call, especially for folks on the go. Answering a phone call while driving is never recommended but if you really have to, then it’s better that you do so using a bluetooth headset so that you have your hands free to do the driving. There are a lot of options in the market and you need to consider a few pointers while deciding which one to get.

  - Multi-point connection - if you carry more than one device then a headset with multipoint connection can actively pair with all of the phones you have.
  
  - Improved pairing - Most bluetooth devices require that you enter a pin in both devices during
pairing, or in the case of headsets use the predefined code. Since Bluetooth v2.1 this feature has been included by default, allowing you to seemlessly pair your devices without entering a pin.

**Multiple ear buds** - Having a choice regarding the earbuds works great towards ensuring a snug fit and eliminating external noise.

**USB charging** - Since USB ports are found everywhere the ability to charge your headset using the same cable as you'd use for the phone is an added advantage.

**Headphones**

The stock headphones that come with smartphones are outright ridiculous, unless you are paying a lot you don't get swappable earbuds. Those phones which are labelled as music edition phones come with headphones that can be said to be passable at best. If you really want to enjoy the music then get yourself a good pair of headphones. There are plenty of good websites and enthusiast forums on the internet where you can get great reviews and also advice for getting a good pair.

**Extra battery**

Most smartphones are power hungry devices and require charging on a daily basis but if you are travelling and you are unable to charge your phone on the way then having the extra battery helps out. However, if you prefer to have more capacity then you can opt for an external battery pack. These are the ones which you connect to the charging port on your phone when you are running low on juice. There are “juice packs” which hold enough charge to last you 3-4 recharge cycles, great for a mini vacation.

Since we have already covered batteries in much detail in the hardware section, we won’t revisit the topic further. All you need to keep in mind is that the
battery pack better have a connector that suits your phone’s charging socket. Most of these packs come with an assortment of connector cables but it pays to be sure.

**Memory Card**

The memory that your smartphone usually comes with is normally sufficient to hold 20-30 apps along with a few images and songs. If you want more then you have to get an external memory card, we’ve covered everything you need to know about memory cards in the mobile/tablet hardware chapter.
LAPTOPS – THE WORKHORSES OF OUR GENERATION

If you don’t own a smartphone or tablet, you’re probably jealous of your friends who do. But if you have either or even both, but no laptop, ultrabook or convertible, you might be missing out on more than just a few features.

The laptop is perhaps the least hyped of all mobile devices. This compact machine has already established itself as an icon of on-the-go productivity. You want to program? Do it on a laptop. Want to edit multimedia? You can do that as well. Be it work, entertainment or communication the laptop is your man Friday. It’s your entire PC in a portable format. You have no shortage of screen space and no shortage of applications. Additionally, you have sufficient storage to host
your entire music collection and quite a number of videos to entertain you while travelling.

**Hardware**

“But why should I pay ₹32,000 for a laptop with a Core i3 processor when I can get a Core i5 for only ₹38,000?” Does that sound familiar? To many of us at Digit, it does – not only are we asked such questions daily by friends and their friends but also by readers on Facebook and Thinkdigit forums and in our inboxes. So is a Core i5 based machine worth its price or would a Core i3 suffice? How about a Core i7? Let’s explore.

**Processors**

If we were to have genies to fulfil our wishes, we’d wish for more powerful laptops! While we may not have genies, we do have processors which can grant our requests for souped up computing devices. These little wonders let us do things such as satisfy the insatiable urge to accelerate a car in the virtual world. While this feat is surely impressive, the processor is also responsible for the most basic of tasks. It’s the primary chip at the core of every laptop determining the speed at which your device will work. Next time you see an advertisement for computing devices, notice how much emphasis is placed on the processors they flaunt. However, you should know that they don’t determine the entire computing performance. Let’s dig deeper to know what this means.

Processors have one job: to process data. When you open a document to edit or launch a browser to flip through Facebook, the load the processor experiences is minimal and for a short while. Scrolling through web pages and documents doesn’t put any significant load on the system but when you want to use the same piece of magic to convert music or video files for playback on your mobile devices, you put heavy load on it. When it boils down to the question of selecting processors, it’s imperative to ask yourself “what do I need from the machine?” “Everything” is not the right answer to the question for two reasons:

1. **Expense:** The more you want in a device, the more cash you’ll have to shell out and you probably won’t even need the features in an expensive gadget. Unless you’re planning on editing a lot of HD video or playing very high-end PC games, you can save your money for better investments.
2. **Usage patterns:** We all have usage patterns. Developers will most likely use IDEs and command line, while administrators would need a good
connection and plenty of windows open. Enthusiasts might want to play
games on the go while designers would be more engrossed in Photoshop
than MS Word.

In most cases, we use our mobile devices (including laptops) to browse
the internet. After all, how many serious gamers have you seen using lap-
tops? (Unless they were gaming laptops which are defined by their graphics
first, CPU second, and size third.) If you aren’t going to push the machine
to its limits, Core i3 is perhaps just as good as Core i5 or Core i7. Heck, even
a Pentium dual core would suffice. For clearer understanding, let’s look at
the model numbers.

**Core Eye(s)**
Regardless of whether the Steve Jobs naming convention inspired the ‘i’
class of Intel processors, their names have an impact on our minds. Our
subconscious minds rate a product higher if it has a higher number attached
to it. This is especially true for tech products where most numbers represent
development stages or versions and increase as they progress. However,
this doesn’t really hold true for processors.

The popular opinion about the names Core i3, Core i5 and Core i7 is that
the numbers represent the number of computing cores on the chip. This is
quite far from the truth. Firstly, multi-core processors from Intel don’t come
in odd number of cores, and the triple-core processors of AMD are quad-
core processors with one core locked out. Secondly, the notion that Core i3
processors are dual-core, Core i5 are quad-cores and Core i7 are octa-core
is also wrong because both Core i3 and Core i5 series processors are dual
core processors with each core implementing Hyper-Threading technology.

Hyper-Threading or HT
technology uses double
register sets making them
appear as two different
processing cores to the
operating system which
in turn helps maximize
processor usage.

One of the significant
differences between Core
i5 and Core i3 is the Turbo
Boost technology present
Laptops – the workhorses of our generation

in i5 that’s lacking in i3. This technology enables the processor to run above its base operating frequency via dynamic control of the processor’s clock rate. It’s activated when the OS requests the highest performance state of the processor. Most other features are almost the same. Core i7 series, however, offers four core processors, each with HT technology making them seem like octa-core processors.

Again, there are generations for each of these series. The most recent generation, launched in June, is 4th generation. As we write this, 4th generation Core i7 and Core i5 mobile processors have been introduced and updated on Intel’s website. The easiest way to find out the generation of an Intel Core mobile processor is to see the first number of the four-digit processor number. For example, both i5-3550 and i3-3240 are 3rd generation processors while i5-2500S and i3-2130 are 2nd generation processors. In case an Intel Core processor number is just three digits, it belongs to the first generation.

AMD processors, on the other hand, are not as easy to identify. The company’s technical documentation page provides definitions for each alpha-numeric character of the OPN (Ordering Part Numbers – the laser markings on AMD processors that identify processors and their specs) on the power and thermal data sheet for each processor family. Follow these links for details of the model numbers: http://digit.in/17ZED7M and http://digit.in/19TPOzu

Specifications

Below are some important specs in a processor you should analyse when deciding on a laptop. We’ll break down and explain each specification:

1. **Clock Speed**: The “more is better” rule applies here but you must remember that a higher clock-speed translates to higher power consumption and shorter battery back-up time. Wisdom lies in understanding the major use of your laptop. If you’re not going to do computation intensive multimedia jobs, don’t be lured by big numbers. For most regular work such as document editing, web browsing or programming, the computation load remains low whereas multimedia jobs such as graphics designing, video editing, 3D modelling and animation require more CPU power.

   Note, however, that while the clock speed-to-performance ratio is stable within the same family of processors, the amount of work done per clock cycle is different for each processor architecture and family. Many more
clock cycles may be required by one CPU compared to another to do the same amount of work if they belong to different families. If they belong to different micro-architectures, a 3.4 GHz model may not necessarily be faster than a 3.1 GHz model, as a famous ArsTechnica article explained some time ago ([http://goo.gl/Xuf1X](http://goo.gl/Xuf1X))

2. **Number of cores**: Salesmen might use the word ‘multi-tasking’ more to their benefit than yours. If you only browse the net and edit documents, even two cores will suffice. For multimedia work, you might need more. The RAM plays an important role in multi-tasking and we’ll talk about it soon. Also, as we already said, most Core i3’s and i5’s are equipped with quad-core processors (dual cores with HT) so you can pick either. Core i7’s are overkill for office work but a necessity for multimedia-heavy applications. On the AMD side, almost all Phenom II processors are either triple-cores (quad cores with one core locked out) or quad-cores and they’re cast in the same mould as lower-end Core i7’s and Core i5’s when it comes to performance.

3. **Intel Turbo Boost / AMD Turbo Core**: Though the terms may differ, both technologies function in more or less the same way. Turbo Boost and Turbo Core increase the clock speed of the processor when workload increases and decrease it with low load. The key benefit of this technology is that it saves battery life. If you can, go for a laptop with a Turbo Boost enabled processor.

4. **Max TDP**: Max TDP or Thermal Design Power is roughly the amount of power the processor consumes. If your priority is battery life and not performance, go for the processors with lower TDP.

5. **Max Memory Support**: This is the amount of memory (RAM) that the processor is designed to address. It determines how much RAM you can add to the laptop. In most cases you won’t be installing more RAM than the processor limits but it’s always better to be sure. E.g. Core i3-2310M can address 16 GB of memory while Core i5-2557M supports only 8 GB!

6. **Graphics Processing Unit**: Graphics processing is one of the system’s most intensive jobs for a couple of reasons:
   a. Graphics processing is computationally intensive by nature. The computation required for calculating the position and colour of each pixel among a million others is high. This is the reason graphics are not processed on the CPU, but on a separate unit.
   b. Graphics processing cannot be stopped. As long as you’re using
the computer, graphics have to be processed. It if falters, you face unresponsive screens and an overall bad experience.

Some processors do come with built-in graphics processing units on the same chip as the CPU. If you’re planning to use the system for graphics-intensive jobs often, the on-chip GPU may not suffice. However for most other cases, they’re sufficient. GPUs built into processor chips are decent enough for a good Windows Aero performance and other tasks. When possible, look for a processor with a higher graphics frequency. There are some features built into the on-chip graphics processors which help you stream videos wirelessly, support better HD playback and faster media conversions and so on. However, while they may appear alluring, fact is, you probably don’t require all the features. For example, if you don’t intend on watching 3D content on your laptop, looking for InTru 3D in the specifications sheet is baseless. However if you’re a developer or a designer, then you could use the extra displays, in which case an on-chip GPU supporting three displays would be better than a GPU supporting only two.

It’s noteworthy that most of the power consumption depends on CPU and GPU. The more CPU/GPU intensive the task, the lesser will be the battery back-up for your system. When the computer boots, the operating system loads consuming the most power required for spinning the hard disk. The same thing happens when you load any new program. Once the program is loaded, the power consumption comes down to a minimum level and thereafter it fluctuates depending on the load produced by the program on the processor. More the processing required by the program, more the power consumption. The same applies to the GPU. If you’re performing multimedia work on the machine, it calls out to the graphics unit for more leverage. Combined, the GPU and CPU provide most of the power requirements of the machine.

There are a few other features which are shown on Intel’s website (AMD comparatively shows only a handful). Let’s go through some features whose availability should be considered as well:

1. **Hyper-Threading:** This technology provides the user with two threads per processor core, thus elevating the performance. Most processors are already bundled with this tech.

2. **Virtualization Technology:** AMD and Intel call it AMD-V and Intel VT-x, respectively. It comes into the picture when you’re trying to run virtual machines using VMWare Workstation or VirtualBox. For some virtualization software such as KVM/QEMU or XEN, the presence of virtualization technology is mandatory.
3. **Virtualization for Directed I/O (VT-d):** If you read the Fast Track to Virtualization we published last year, you’re probably well acquainted with how storage is handled in virtualized environments. This technology helps improve the performance of a virtual machine when it tries to access data on disk. The overall concept behind VT-d is hardware support for isolating and restricting device accesses to the owner of the partition managing the device.

4. **VT-x for Extended Page Tables:** This technology helps the virtualization software access memory for virtual machines and improves performance further.

5. **Thermal Monitoring Technology:** This helps reduce the power consumption as well as helps protect the hardware in case of over-heating. One useful add-on for sure!

6. **AES New Instructions:** BitLocker, the disk encryption technology introduced with Windows Vista and present in Windows 7 and Windows 8 uses AES algorithm for encryption/decryption. If you plan to use BitLocker on your laptop, this feature would improve performance by a noticeable margin. Besides this, you wouldn’t find any other use for it (unless you’re designing software which employs this feature).

Though what we just mentioned is in reference to laptop processors, (i.e. the regular bulky notebooks), the same stands true for ultrabooks as well as convertibles since they share similar hardware despite different form factors.

When opting for an ultrabook, ensure that it has proper cooling and a processor with Turbo Boost. While mobiles and tablets have lower processing requirements, we can’t say the same for ultrabooks which take on more load. Depending on the load, the heat generated would rise. Lack of cooling could mean shorter battery and component life. Cooling, in most cases, is availed by ventilating holes at the bottom of the machine. Make sure that there are enough air vents before falling for looks.

**GPU**

**All work and no play makes for a dull laptop**

Hearing that a laptop comes with “1 GB of Graphics Card” is not uncommon. One scratch under the surface and you would find that almost all graphics cards come with 1 GB or more of memory. But is it just the ‘1GB’ that matters? Obviously not. If it did, all laptops and all graphics cards would have been the same and the rest of the GPU specifications wouldn’t have mattered at all.
Beyond “1 GB” Graphics

If you look at the specs of a laptop, the two prominent things mentioned are the GPU model number and the amount of memory dedicated to the GPU and most dealers would care about just that much disregarding the fact that there is so much more to it. First things first – unlike processors, both AMD and NVIDIA use higher numbers in each series to denote better GPUs. So an NVIDIA GeForce GT 635M is going to be better than NVIDIA GT 630M and you can almost depend on the processor numbering in each series to rank one GPU better than the other. But then, do we settle down with model numbers alone? Nay, there be more to it.

Before we talk about which ones are good, it would be wise to ponder over the question “how does a 900 MHz GPU outperform a 3 GHz CPU in graphics performance?” Let us consider one of the best mobile processors available in the market – Core i7-4930MX Extreme Edition and one of the best mobile GPUs in the market – NVIDIA GeForce GTX 780M. The former runs at 3GHz clock speed normally and can go up to 3.9 GHz with turbo-boost while the latter runs at 823 MHz clock speed. If you look at just these two numbers, the graphics card looks like a kid. Expose the fact that the processor has only 4 cores (with the capacity to churn 8 simultaneous threads) while the graphics card has 1536 such processors running, you get the large part of the picture.

Let us do a very rough calculation of speeds with assumptions favouring the CPU:

i. Suppose the CPU is able to work on 8 threads at a time at 3.9 GHz (that wouldn’t happen because there are actually only 4 cores to do the work). The total number of computing cycles it is running per second = 8 x 3.9 x 10^9 = 31,200,000,000.

ii. The GPU is working at 823 MHz with load on all its 1536 compute cores. The total number of computing cycles it is running per second = 1536 x 823 x 10^6 = 1,264,128,000,000

Even with such insane favours to CPU, the GPU is about 40 times faster.
Laptops – the workhorses of our generation

than the CPU. Though it might give an impression that running 40 such CPUs would get you the power of that single GPU, it would be wrong. Reasons:

1. GPUs come with dedicated hardware logic to calculate upon 3D data which makes them even more powerful than the CPU when it comes to computing 3D objects.

2. GPUs would get snail paced if you asked them to do what the CPU does. This is because GPUs are Single Instruction, Multiple Data (SIMD) systems. What this means is that GPUs will show their true monstrous number crunching abilities only when one single instruction can be executed on an array of similar data. Have a look at the inset note about SIMD to learn more.

3. GPUs would be slow if they were to use the normal methods used to access data in RAM. The amount of computation they do requires excessively fast memory I/O and their memory architecture is built to serve just that. More about this shortly.

SIMD systems, though come with multiple processors, they require that all processors be working on the same instruction at a time, however on multiple data. Hence, if one processor in a SIMD system is adding two numbers, other processors would also be adding two numbers, however a different set of numbers. SIMD offers excessive performance gains at the cost of programmer having to take care of intrinsic details of how the algorithm would run.

The graphics memory

As we just said, graphics cards are able to compute at such speeds largely because of how they access the graphics memory. The CPU RAM module is accessed serially i.e. the RAM modules of the
system can send back one piece of data to the CPU on one access. Graphics memory on the other hand is designed to serve more than one computing core at a time. This happens due to clever organisation of memory for each processor and the way processors are grouped.

**Needs and Wishes**

If you are not going to game a lot, skip a GPU. GPUs are built to let you play games. Multimedia editing software such as 3Ds MAX, Adobe Photoshop and After Effects too utilise GPU’s powers. GPUs are power hungry devices. They can consume as much as or more power than the CPU. Make sure you are going after one only if you need one. If you are going to do multimedia editing (video editing, 3D modelling, animation or heavy image editing) or gaming, you’re better off with a dedicated GPU. Almost all other requirements can be fulfilled by on-chip GPUs built into processors.

That said, most mainstream laptops come with a GPU and you are out of choices. If you are planning to buy a laptop from the mainstream segment (in the ₹30K – ₹50K price range), look for ‘switchable’ graphics. Such machines utilize the processor’s on-chip graphics for most cases and use GPUs only for graphics-heavy jobs which cannot be served well by the on-chip GPUs.

You might wonder why we left HD video playback out of the list of GPU-intensive jobs. It’s because only a few media players such as Windows Media Player and iTunes utilise the powers of GPU for video playback while the

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**NOTE: What's SIMD?**

SIMD stands for Single Instruction Multiple Data and is a computer architecture which allows fast calculation on an array of similar data. A GPU is a SIMD type system while a modern CPU is Single Instruction Single Data (SISD) processor with Symmetric Multiprocessing (SMP) (they come close to MIMD architecture). A CPU runs multiple threads each of which runs on its own. They all can run different instructions in the same clock cycles, e.g. while one is trying to do multiplication, second one can be doing subtraction, a third one could be trying to access memory and so on and so forth.
ones that are more used in our day to day life (e.g. VLC Media Player) do not use GPU all that much.

**More wisdom for more efficient GPUs**

Just because a GPU is more powerful than the other, does not mean you should always get a better one. The key factors are your budget, the amount of graphics load you would put on it (gaming and 3D modelling are more intensive than image editing). If your needs are minimal, go for a basic model and please do not be misguided by the amount of memory the chip has.

The important parts of the spec-sheet are:

1. **Number of stream processors**: The number of processors on the GPU to calculate on the graphics data. These are also known as ‘cores’ or ‘shaders’. The terminology is such because of their historic use of processing a 3D world rendering where they calculated the color (or ‘shade’) of pixels. Since some time now, pioneered by NVIDIA, they can be used by some general purpose programs to offload some specific types of calculations. The technology is termed ‘CUDA’ by NVIDIA and they call the same ‘CUDA cores’. The higher this number, the better the card is.

2. **The GPU clock speed**: This one is the speed at which the GPU would run and is analogous to the core clock speed of a CPU. The higher it is, the more powerful and power hungry your GPU would be.

3. **Memory frequency**: The speed at which the dedicated GPU memory operates. The higher the better. If you look at spec-sheets of manufacturer websites, chances are you will get confused because sometimes they mention the memory frequency in ‘Gbps’. That would be the data transfer rate which is 4 times the memory frequency. Memory frequencies are measured in MHz and should range between 1200 to 2000 MHz.

4. **Memory Size**: Though we have told you that memory size is not the only parameter to rank GPUs, they do come in picture and if you can, get NVIDIA GPU memory hierarchy
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one with more memory. More the memory size, the more data it can hold and games do run faster on GPUs with more dedicated memory.

5. **Interface width:** A GPU is 64-bit processor. It can read 64-bits in one clock cycle. Also, we know that a GPU can have many cores, which means that they all need more data from the memory to do more work. To accelerate things, GPUs read from more than one memory banks at one time. The more they can read, the more they would be able to process. Interface width ranges from 128 bit (64 x 2, for lower end GPUs) to 256 bits (64 x 4, found in high end GPUs). Desktop cards may have interface width of up to 384 bits.

**What’s on the menu?**
You cannot just wake up one morning and start building a laptop (and that is true for all mobile devices). We are limited here by the choices offered. Both AMD and NVIDIA offer a commendable range of GPU models to choose from.

NVIDIA GPU model numbers end with ‘M’ or ‘MX’. They usually have same or similar model numbering as of their desktop counterparts. For example, GeForce GTX 780 is the desktop card while GeForce GTX 780 M is the laptop version. The similarity of numbers in their model numbers is only an illusion because the performance and specifications do not match. A mobile GPU is less powerful than its desktop counterpart. Current generation of laptops come with the GTX 6XX series GPUs while the GTX 7XX series has already been released and are making their way to the shelves.

Similarly AMD’s Radeon 7XXXM series GPU are currently present in the market and offer competitive performance for graphics operations.
AMD too have updated their website to reflect the availability of the new 8XXX series of mobile processors.

Which one to choose depends more on your budget and graphics requirements than on company. It is recommended that you check the various GPU configs and depending on your requirements and parameters explained here, pick the one which suits your needs.

However, owing to its popularity, usage in supercomputing projects and research – NVIDIA allows you to play around with the GPGPU (General Purpose GPU) programming more than AMD. They also provide you with more help, manuals and documentation. So if you plan to play around with a GPU’s capability in general purpose programs, you should read about CUDA (start here: http://goo.gl/QMebo) and go for NVIDIA if you need it. Except this one undue advantage in GPGPU programming, both sides have almost the same performance.
SOFTWARE FOR LAPTOP

Find out the interesting ways in which software interacts with the underlying hardware when it comes to the latest generation of portable PCs

Operating systems and software for laptops doesn't differ in any respect from OSes and application for desktops. Though the recent spate of convertible laptops to hit the market has blurred the distinction between a laptop and a tablet. This can be in a large part attributed to Microsoft which has lead the convertibles bandwagon with Surface, where it wanted to entice both the laptop and tablet users to gravitate towards their platform. In this section we’ll be discussing the operating systems that run on laptops.

Operating Systems
We’ll be primarily discussing four operating systems: Windows, Linux, Mac OS X and ChromeOS. Applications for these systems are well self-explanatory, nearly all applications have been ported to each of this OSes and the apps which can only run in their native environs can be executed using an emulator like Wine or Cross Over.
Windows
Windows has been around from days of Windows 98 when people used to lug around laptops weighing around 4 kilos to the current crop of sleek, ultrabooks powered by Windows 8. We’ll not be delving into the past and will only talk about the latest iteration of the operating system. From the get go, Windows 8 has been about Microsoft trying to get a piece of action in the mobile devices market and thus Windows 8 introduced significant changes to the platform, which were primarily focused on improving the user experience on tablets. The entire UI has been rebuilt from scratch based on the new “Modern” (previously Metro) design language. The start button and menu have been done away with and they’re now replaced by a Start screen with dynamically updated tiles laid out in a grid.

Windows now places increased importance on cloud-based services, with providing out-of-the box integration with a lot of services like Windows Live, Xbox Live, Skydrive, social networks and other such online services. Microsoft also introduced an digital distribution system geared towards touch-based applications called Windows Store (as opposed to Windows Phone Store). Apps from Windows Store run with a new set of APIs called Windows Runtime. This API supports programming languages such as C, C++, VB.NET, C# and HTML5 + JS. As mentioned earlier these are not the normal apps but are geared towards touch-based interaction and hence follow the Modern UI design language. Windows for the first time has also been made available for ARM based machines where it is called Windows RT. Windows 8 also features the much maligned Secure Boot feature from UEFI which uses a public-key infrastructure to verify the integrity of the OS and prevent unauthorized programs. The problem with this is that if a user wants to install a different OS for example, Ubuntu onto the device then they’ll not be able to do so as it requires their program (bootloader) to be signed.

Windows 8 met with a lukewarm response, the new design language has faced much flack for being confusing and difficult to learn. The interface
is especially difficult to navigate when using a keyboard and a mouse. It also met harsh criticism for making Windows Store a closed platform controlled by Microsoft as opposed to the open development and distribution system followed by the previous versions. The general consensus is that the company is trying to push the desktop user towards touch-based systems.

**Linux**

Purists would have us write GNU/Linux instead of only Linux. Linux by itself is only a kernel it requires a lot of embellishments and additions which are provided by GNU to provide you with a useful operating system. Linux is the go to operating systems for sysadmins when setting up servers, but desktop and laptops are where Linux has not been able to leave a mark. Even Linus Torvalds has a few misgivings about that, during his interview at Aalto University in 2012 mentioned that “I started Linux as a desktop operating system. And it’s the only area where Linux hasn’t completely taken over. That just annoys the hell out of me.” In the recent years the popularity of Linux has been on the rise, this can be attributed in a large measure to the excellent work carried out by the maintainers and developers of distributions, which are better known as distros.

Few popular mainstream distros are Ubuntu, Linux Mint, Debian, Red Hat Enter-
prise Linux, CentOS, OpenSuse, Arch Linux, Gentoo. These distributions usually include the Linux kernel, supporting utilities and libraries and additional application software. Most of these distros come equipped with a GUI usually GNOME or KDE. Linux was never meant to be a desktop operating system, initially it only found usage on servers. A lot of work has gone into improving the turnaround time for improved I/O performance. Projects like upstart and systemd are being actively developed to improve the boot time.

Most of the popular applications out there are now available for Linux like Mozilla Firefox, LibreOffice, Blender, Chromium, Adobe Reader to name a few. Increasing number of proprietary desktop applications are also being ported to Linux. For example nearly all high end animation and visual effects software such as Autodesk Maya, Softimage XSI and Apple Shake are available for Linux. Linux now is also able to run Steam and Desura, which are video game distribution platforms. Apart from these two a lot of companies are actively porting video games to Linux.

**Mac OS X**

Mac OS X has remain nearly unchanged from its introduction with Cheetah to the upcoming Mavericks. It is built on top of the Darwin foundation which was adapted from NextStep OS which was developed by Steve Jobs and his team during his stint at NeXT. iOS, the operating system which powers the iPhone, iPad and iPod are all powered by the same foundation. They share a lot of frameworks and libraries which makes development on both these systems very easy.

Mac OS X has built for itself a host of interesting features like Automator, for creating automatic workflows of task, Boot Camp which makes installing other operating systems like Windows 7 or 8 a breeze and Time Machine, an automated backup utility. These are in addition to a brilliant set of tools that Mac OS X makes available out of the box – Safari, the WebKit powered default web browser; iPhoto, a photo management application much like Picasa; iMovie, a simple video
editor for the run-of-the-mill video editing tasks and last but not the least Garage Band, a brilliant software which allows the user to record and mix music or podcasts.

Mac OS X continues to show brisk performance in comparison to PC sales post Windows 8 launch. It currently accounts for about 7.06% of the worldwide PC sales. What has worked for Apple’s desktop and laptop lineup - iMac, Mac Mini, Mac Pro, MacBook Pro and the MacBook Air - is the complete control it wields over the hardware on which it’s operating system is running. This ensures excellent performance along ease of support and maintenance for the company.

Chrome OS
Google’s Chrome OS is a Linux-based operating system which works exclusively with web applications. It follows the same dichotomy as Google Chrome, the open source project which powers Chrome OS is called Chromium OS, while the Chromium OS only ships on specific hardware from Google’s manufacturing partners. Devices running Chrome OS are called Chromebooks and are currently being produced by manufacturers which include Google, LG, Lenovo, Samsung and Acer. The latest entrant is the Chromebook Pixel, which is priced six times higher than the normal chromebook. It’s targeted towards user who have a lot of dough to spend on sleek devices which just run web applications.

Normal web applications written in HTML5, CSS and JavaScript would work admirably on this platform. But Google advises developers to utilize it’s Package App Platform. Packaged apps are modified Web applications. But they look and feel like traditional “native” applications and lack the usual embellishments like the address bar, tab strip and other elements associated with an application running inside a browser. Packaged apps load locally and remain functional offline when the Internet connection is
not available. Originally, the user interface was simply the browser chrome, a new build in April 2012 offered a choice between the original full-screen mode and overlapping, re-sizable windows found on a usual operating system. Chrome OS implements this feature using a window manager called Ash running on top of the Aura graphics engine.

Chromebooks and by extension ChromeOS are specifically geared towards people who do have high requirements. It is usually suitable for school children or as an extra laptop at a home where the most you want to do is either stream a video or open a document or a spreadsheet. The advantage here is that all your processing and storage is done on the cloud which leaves you with a very snappy device for your day-to-day tasks.
LAPTOP ACCESSORIES

There are accessories which are indispensible and then there are some which only amount to extra space. We list for you some of both types, and then some.

**Cooling Pads**

If you use your Laptop for gaming or put a lot of computational load on it, a cooling pad is an inevitable accessory. While not a very portable accessory, it is helpful when demands are high and you have to push the machine to its limits. In most cases you wouldn't need it when you are just browsing the web or working on documents or sheets but when you are gaming or using graphics/design software, it's better to use them than not.

This tool can buy you peace for Indian summers too when the temperature touches 45 degree Celsius. When you are using the machine lying down on your bed (remember though, that's a bad posture), the ventilating holes at the bottom of the machine get blocked. A cooling pad would help avoid that, too. There are different designs. It is wise to purchase one with adjustable height and fans which maintain airflow more uniformly and can help fill cool air in as many vents as possible.
USB Speakers
A Laptop usually comes with a set of speakers that are just barely acceptable. If you have a laptop with speakers from JBL or Altec Lansing, you are probably not going to need USB speakers. You would only need them if you want your laptop to amuse your ears from more than a couple meters away.

If you want to listen to music at higher volumes in your living space, it would be better to get a 2.1 channel subwoofer speaker set than USB speakers. USB speakers draw power from your laptop and that would result in shorter backup time. They are recommended only if you want to game or play multimedia on the go and your laptop’s built-in speakers do not meet your expectations.

Pen Drives
Not necessarily a ‘Laptop’ accessory, they serve multiple purposes from taking quick document printouts to handy backups. If data privacy is your concern, you can use one of the many device encryption software available in the market (e.g. TrueCrypt) or just go with Windows’ own BitLocker. They can also contain an alternate OS (e.g. a Live Linux OS) to help you boot into a recovery environment before you launch the factory-reset wizard. It’s one of the most useful accessories and a must-have.

Mouse
If you think your touchpad is a good replacement for a mouse, wait until you try editing a picture. Even if you are not a graphics designer, a mouse comes in handy when you need to work fast. From small actions such as switching windows, scrolling, zooming, opening file properties to video editing, gaming and image editing, a mouse is immensely useful. Depending on your dislike towards wires and the weight of your wallet, you might also want to opt for a wireless one.

Webcam
Quite obviously, if you need this, your laptop is too old and it’s advisable that you get a new one. Most new laptops come with a webcam built above the screen to help you video chat or just click a picture. Portable webcams are useful if and only if you are not ready to replace your age-old laptop with a new one or, through some extremely foolish act of carelessness, you damaged the one on your existing laptop, and still want to be able to video chat with buddies.
**External Hard-disk**

External hard-disks are not really power efficient accessories. Nonetheless they are one of the most useful ones. From taking full-machine backups to storing extra videos and music, they can help in a number of scenarios. Most laptops come with a genuine version of Windows and either a recovery partition or recovery disks using which you can restore your notebook to its factory state. That said, once you perform that action, all your files, software and preferences are gone. Unless you are ready to suddenly lose all of your work and your massive “multimedia” collection, you should probably get a hard disk to backup your content from time to time.

**Battery**

It is probably needless to emphasize the importance of battery for a laptop. An extra battery pack is not really required for everyone. If you spend more than a couple of hours without power source, it is advisable to get a secondary battery which could be replaced on the go. All you would need is to either shut-down or hibernate the machine and replace the battery.

Most Laptops run for about 2 to 3 hours with a new battery. Ultrabooks, due to their design and component composition last about 4 hours. If battery backup time is your main concern, it is advisable that you purchase an ultrabook. If not, get a laptop with low power consumption components. Also, take good care of your battery. Get yourself a secondary battery only when the one which came with your laptop starts degrading and you feel the need for one. For frequent travellers, it’s a weight worth being carried around.

**Laptop Bag**

If your laptop did not come with one, go get one. If you have a choice, we would strongly recommend the backpack over the ones that hang on the side. Backpack bags often have better compartments to ensure that you have kept the machine and its various accessories in the correct places. They are much easier to carry and can, obviously, be used to transport something more than just a laptop.

**Travel Adaptors**

Put simply, this is the single most important accessory that any travelling geek requires in his kit. There is no point in carrying multiple chargers and cables if your charger won’t even fit in the socket in the first place.
**Keyboard**
Laptops come with keyboards, don’t they? Yes they do! And for the same reason having an extra keyboard sounds like overkill. An extra keyboard is useful when your laptop did not come with a number pad and you are in need of one by all means. The other reason would be to be able to operate your laptop from a distance which in most cases should not be necessary.

**Laptop stand**
Quite often the term is used in conjunction with cooling pads. The ones we are talking about here are the ones which elevate the laptop to your elbow height. These are pretty handy if you want to use your lappy while sitting on your bed with legs crossed. Otherwise they are not of much use. They may or may not come with cooling features. If they do, it’s always an added benefit! ([http://dgit.in/13XAabS](http://dgit.in/13XAabS))

**Memory card reader**
If you are not someone with a dedicated digital camera, you shouldn’t even care about them. Most laptops do come with card reading slots built into them and would probably support SD/MMC/MS/MS Pro types and that should be enough. You should get one only if those slots are difficult to use or you use a type which is not supported by your laptop (chances of such an occurrence would be low). Since most cameras come with a USB port and allow downloading pictures directly onto a PC, this shouldn’t really be a concern.

**Headphones**
Though it might sound like a marketing punch-line, headphones make your laptop completely personal. Whether it is the sound effects of a song you would love to listen or avoid disturbing other mates in the room, headphones (or earphones) allow you to do that. It’s one of those accessories which do not consume a lot of space but elevate entertainment as well as usability to a higher level.

**External DVD writer**
Most laptops come with a built-in DVD reader/writer device. If however you purchased a machine which did not have a DVD writer, you might want to buy one for the bad times when you have to reinstall the OS in absence of all other help or install the latest game demos from the Digit DVD. For
most other cases, you would perhaps not need an optical device (thanks to pen-drives and the Internet (http://dgit.in/13XAAbS).

**Keyboard skins / silicone covers**
They stop dust from getting under your laptop keys but there is a downside to that: keyboards are one of the places from where the laptop gets air and dissipates heat. While the air suction is minimal and even after placing the skin, the air flow does not get affected to any significant level, they do block heat from going out and that is a bad thing. You should avoid them in most normal cases and use them only if you regularly work on your laptop in dust-prone conditions.

**Screen guard**
They guard the screen against scratches but can cause irritation if not applied correctly. While keeping your screen safe is important, it is worth keeping in mind that a guard improperly stuck might cause air bubbles to accumulate at places and that would cause disturbances in reading. Also, they can get damaged with heat and an attempt to remove one in such a case would damage the screen. Unless you use swords, knives, axes or blades near your laptop, it is better you do not use them.

**USB hub**
Nowadays, any and every gadget interacts with your PC via USB and unfortunately, most laptops have a chronic shortage of USB ports. This is where the USB hub emerges as the saviour, easily doubling the number of ports at your disposal in one fell swoop.
Chapter #10

Complete Buying Guide Including Top 10 Devices

Now that you know everything there is to know about portable hardware, it’s time to put all that gyan to good use. Here’s a handy guide to help you make the most informed purchases.

Choose your platform

In a post-PC era, the consumer is spoilt for choices in terms of a device’s operating system. About a decade ago, when a laptop was all that constituted as a portable computing device, we had limited choice of which platform to hop on – Microsoft’s Windows, Apple’s Macintosh or no one’s in particular Linux. Unhappy with Windows Vista? Erase it and go back to
Windows XP. Want to experience the Windows ecosystem on your Intel-powered iMac or MacBook? Easy peasy, just go to Mac OS X’s built-in Boot Camp utility and you can dual-boot your Mac with Windows. Bored with either of the two? Linux, championing the cause of open-source, is always available – for free – and with an assortment of flavours.

Despite Microsoft Windows’ monopoly on Intel and AMD based x86 and x64 machines, it was still quite easy to pop in a CD or DVD into your laptop’s optical drive tray and wipe out one operating system for another. Windows for another flavour of Windows, Mac OS X for Windows, Windows for Linux, and so on. It wasn’t exactly child’s play, but it wasn’t exactly rocket science either. The idea of switching between OSes and platforms was acceptable, even if it wasn’t endorsed by device manufac-

turers. That was back then. It’s a different world we inhabit now, a world where manufacturers of smart handheld devices and the platforms they endorse frown upon switching OSes on any of their handheld devices up for purchase – forget switching, even minor alterations or tweaks to a device’s software void its warranty. This means that the non-tech savvy, basic consumer (which forms majority of the consumer base) is stuck on a platform when they buy a mobile device – be it a tablet or smartphone. Unhappy with your platform? Want a different OS? Buy a new device. Sorry. Take it or leave it.

Welcome to the Post-PC era where Google, Apple, Microsoft, Blackberry and also Nokia, Samsung, Mozilla, Canonical and a few others possessing an enterprising brain are busy constructing walled gardens, competing with each other. Walled gardens (re: platforms) that are being erected on every device to keep users engaged and entertained within that environment, where they shouldn’t feel or have the choice to migrate to another readily available platform easily. However, with so many companies
vying for your attention and the ensuing competition among brands, it’s a healthy marketplace, ripe with choices for the customer. But with the wider playing field arises the problem of plenty, and far from being spoilt for choices it’s sometimes downright confusing when it comes to deciding which platform or operating system you should consider on your smart device. That’s where we come in.

**Laptops & Hybrids**
As far as laptops, ultrabooks, hybrids or 2-in-1 tablet-laptop devices go, the choices aren’t too many and Windows continues to dominate these form factors. You might come across cases like the Microsoft Surface Pro and Surface RT devices, if at all you count them as hybrid device; given the difference in hardware between the Microsoft Surface Pro (an x86 device) and Surface RT (an ARM device), you may find differing versions of Windows (Pro and RT, in all likelihood), but that still counts as a differing flavour of Windows and you’re still tied down to Microsoft’s ecosystem. The early ASUS Transformer devices all embraced Android as the platform of choice, the first few clamshelled hybrids to do so.

At Computex 2013, we saw what ASUS claims to be the first device to run Android and Windows 8 simultaneously, the Transformer Book Trio -- which houses an Intel Core processor in its detachable keyboard (with support for Windows) and an Intel Atom processor on its screen / tablet part (supporting Android). But we expect such products to be few and far in between, giving you the choice of two different OSes (platforms) on purchase. Bottom line, as far as laptops and ultrabooks go, even hybrids for the most part, you’re stuck with Windows 8.

As long as it’s a traditional x86 notebook, nothing stops you from installing a flavour of Linux or even an unofficial Mac OS X on your ultrabook -- the rules of engagement in this case are the same old. But wherever you have a hybrid laptop running a flavour of Android or Windows RT, switching to a different OS may not be as clear cut, and the greatest detriment towards indulging in such an act would be the impending fear of voiding the device’s warranty.

**Tablets & Smartphones**
While we restrict ourselves to only devices based on the ARM architecture, which constitutes almost all smartphones and tablets, the biggest battle rages between iOS and Android. Both are extremely popular platforms,
the latter more so now with a flood of sub-10k devices, while the former more resonant with affluent consumers who don’t compromise on quality. While considering iOS, you’re restricted to just two devices -- iPhone and iPad -- whereas Android is proliferant on a multitude of devices from a variety of manufacturers, and all sorts of form factors. iOS and Android are both extremely popular among developers as well, ensuring any supported device you buy will have a ton of apps -- not just now, but also in the future. iOS appears to be more polished overall compared to Android, with even third-party apps and menus -- it benefits a lot from Apple’s tight control over the platform. Android, in many ways, is a more open and thereby a far more fragmented ecosystem in comparison, where every device manufacturer having the freedom to skin and tweak the OS as per their whims. So where Android will look (and even behave) different from one smartphone and tablet to another, you won’t face any such ‘issues’ with iOS. You should buy into Android if you’re heavily integrated into Google’s services and love the freedom it offers, while iOS should be your platform of choice if you’re looking at experiencing arguably the best touchscreen OS out there.

Windows Phone and Windows 8 for smartphones and tablets, respectively, have joined the hunt for consumers relatively late compared to the big two. On a touch-enabled device, the platform appears relatively fresh and different than both iOS and Android. The integration of Facebook, Microsoft Office and Xbox LIVE at the OS’ core gives the platform a slight edge over its competitors, but it still lags behind the other two in terms of wooing developers and boasting of a formidable app ecosystem. It’s worth considering if you want to try something different than iOS and Android for a change.

Blackberry (formerly RIM) recently went in for a reform of sorts, having not only changed its company name but also developed a brand new OS
from the grounds up -- Blackberry 10 or BB 10. The brand new BB 10 OS is re-imagined for touch input without compromising on Blackberry’s traditional keypad experience. What’s more, the OS can run Android apps on it through a runtime layer. For Blackberry users who haven’t used it, the OS is a breath of fresh air. With Blackberry claiming the presence of over 1,20,000 third-party apps on its app store, seems like the BB platform is poised to challenge the likes of Windows and eventually iOS and Android for a piece of the mobile market. If you’re a Blackberry fan disappointed with the company (in the last year or so), and considering a switch to iOS or Android, don’t give up just yet. You’ll notice that with the latest incarnation of BB 10, the OS is comparable to Android or iOS in terms of features and options.

**Decide what hardware you’ll need**

Now that you have some idea about the major platforms that are up for grabs while considering to buy a new smart, portable device (be it a laptop, smartphone, tablet or hybrid device), let’s now get into determining how to choose between different hardware configurations found on most of these devices.

**Laptops & Hybrids**

As far as laptops and ultrabooks are concerned, also tablet-ultrabook hybrids based on x86 platform, there continues to be an abundance of Intel-based machines launched by OEMs, and the number of AMD-based notebooks remains low. As you may know, Intel officially unveiled Haswell last month, its fourth generation of Core processors based on a new 22nm fabrication process which promises to deliver better performance (especially onboard graphics) and better power efficiency than ever before. If you’re looking at purchasing a laptop or ultrabook with the latest and greatest hardware then you simply can’t miss out on the new Intel “Haswell” enabled ultrabooks which should start selling in the Indian market very soon. AMD APUs in the past haven’t matched up to Intel’s sheer processing speed, as per our experience, and we don’t expect it to make any significant inroads this year as well. So if it’s speed and processing prowess you’re after on your ultrabook or notebook, Intel is still the way to go.

However, historically, AMD’s lower-end APUs do offer slightly better graphics than Intel’s onboard chips -- especially in the 10 or 11-inch
netbook form factor space. That might change with Intel’s Haswell chips where the onboard Intel HD 4000 series GPU’s supposed to run faster than Usain Bolt, we can’t say for sure, not having tested any of the Intel Haswell machines yet. As far as external GPUs are concerned, NVIDIA’s GeForce 700M and AMD’s Radeon HD 8000M series of mobile GPUs have already made their way onto laptops and ultrabooks last month. Not having benchmarked any of these new mobile GPUs firsthand, we can’t really comment on their performance, but NVIDIA’s GeForce 780M seems to be stealing a march on the AMD Radeon HD 8970M graphics. However, you should only worry about such discrete GPUs if you desire to play the latest games at unrestricted settings on your laptop or ultrabook.

Displays are improving in terms of screen resolutions on laptops and ultrabooks, in recent years -- and rightly so, which self-respecting laptop will see its larger screen size pack in lesser pixels than a 5-inch smartphone’s? Products like the retina display Apple MacBook Pro, Toshiba KiraBook and Google Chromebook Pixel have led the way in recent months and are forcing laptop manufacturers to up the ante as far as higher-resolution displays are concerned. The norm for 11 to 15-inch laptops is still stuck at 1366x768 resolution, but as we said the number of mid-ranged laptops supporting 1600x900 or Full HD 1920x1080 pixel resolution is slowly and surely on the rise.
Another consideration is whether to purchase an ultrabook with a detachable tablet screen? In our experience, such products remain as a niche right now, and even users aren't lapping up 2-in-1 convertibles or tablet-ultrabook hybrid devices in a hurry mainly because of their expensive price tags right now.

However, if price isn’t an issue, and if you desire the novelty and flexibility of such a hybrid device, by all means pursue them. We even witnessed some of the best Intel and Windows 8 Convertibles at Computex 2013 last month, and you can find out more about them at http://www.thinkdigit.com/slideshows/.

**Tablets & Smartphones**

In the matter of tablets and smartphones, the specs to look out for are quite similar. Since we’ve covered SoCs and other underlying hardware characteristics of ARM-based devices in a previous chapter, we won’t be going into much detail about it here. But suffice to say that when you’re talking about a tablet or smartphone’s processing chip, the latest hardware is always the best. Quad-core is better than dual-core, 2 GB RAM is better than 1 GB RAM. And as smartphones and tablets gain popularity as a compact computer, so does the need for them to be fast and packed with the latest and greatest hardware features that much more important -- especially with tablets. Because, remember this important point about tablets and smartphones -- unlike PCs or laptops, it is difficult to service their parts as most of them (except the battery) are soldered onto the PCB. So whenever you buy a smartphone or tablet, just stretch your budget a bit and get the best possible hardware configuration that you can afford at any point in time.

Other than that, here are two specs that you should pay special attention to and matter a lot:

**Display:** The manufacturers have gravitated and frozen upon two form factors, as far as tablets are concerned: 7-inch and 10-inch. While the 7-inch tablet does offer a huge advantage in terms of portability, the 10-inch form factor is better for multimedia and gaming experience. As far as smartphones go, 4-inch screens have become the lowest benchmark, and there are all sorts of variations being adopted in smartphone screens that take them very close to the tablet territory -- the 6.5-inch ASUS Fonepad, for example. In terms of pixel resolution, aim for a 720p display at the very minimum, and 1080p ones if you can afford. As you’ll be staring at
the screen of your phone or tablet all the time while you use it, you better make it well worth the effort.

**Battery:** If there is one single thing that matters beyond everything else on a tablet or smartphone then it’s the battery capacity of the device. Devices try to strike a delicate balance between core processing power and power efficiency, and it’s a never-ending struggle. The fact that portable power banks are getting popular as a phone and tablet accessory is reason enough to believe that our smart devices (especially our smartphones) don’t make it through the day without a little recharging in between. iPads have the best battery life, among tablets, in our experience, while smartphone battery lives all continue to disappoint. We can’t stress this point enough -- the higher your smartphone or tablet’s mAh number (battery capacity), the better for your peace of mind.
Begin haunting review sites
Identifying and deciding upon the platform and hardware requirements for your smart, mobile device is only part of the battle won. Now that you know which laptop, tablet or smartphone you’re willing to buy, it’s a good habit to do a thorough roundup of the World Wide Web and be absolutely sure that you aren’t suffering from self-delusion and hung up on the wrong platform or device; best to make sure that the product you’re buying isn’t a dud. The notion of buying a smartphone just because a friend suggested you to do so is a dangerous one in today’s age. Thorough research is the name of the game and there’s no such thing as too much research, when it comes to buying digital goods.

Therefore it’s wise to get into the habit of double, triple checking a mobile device on trusted third-party websites to get an unbiased, fair assessment about it. Besides thinkdigit.com, you can always stop by anandtech.com for detailed reviews on almost all noteworthy products in the tablet, smartphone and laptop space -- believe us when we say that you need at least half an hour to read any in-depth article on this fantastic website. If, however, you’re short on time or can’t find the product you’re looking for, we also highly recommend stopping by theverge.com for an insightful perspective on a popular tablet, smartphone or laptop. And if you haven’t had enough of the intelligent reviews and assessments of anandtech.com and theverge.com, you can always stop by pcmag.com and read their experts’ reviews on all things tech -- up until recently, we had a content sharing deal with pcmag.com, and we have the utmost regards towards its editorial content, undoubtedly one of the best in the world as far as all things concerning tech. Wired.com is another very well respected destination for reviewing tech products, and we at Digit frequently link to their articles within our own.

While you’re at some of these or other online gadget review portals, remember to pay equal attention to the comments section of any review article. Passionate readers for or against the product ensure to get their point across and add a whole new level of information and insights in addition to the points conveyed and summarized by the original reviewer.

Tech forums (like our very own at thinkdigit.com/forum and others around the Web) are a great way to sense the general mood towards a popular device. We know that Facebook pages are fast replacing good ol’ forums of yore, but some of the oldest and most popular ones in their respective field continue to go strong. One great thing about a tech forum
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<tbody>
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<td><strong>Our list of the Best Smartphones with a right mix of performance and features. This ranking is based on phones released upto 28-05-2013</strong></td>
</tr>
</tbody>
</table>
| **1 | HTC ONE**  
The HTC One takes the top spot in our list of best smartphones. Read the review to find out why. |
| **2 | SAMSUNG GALAXY S4**  
Best Android phone for feature junkies. Super fast 8 core processor and good battery life. |
| **3 | APPLE IPHONE 5**  
Exquisite build quality, blazing fast performance, very good battery life - need we say more? |
| **4 | GOOGLE NEXUS 4 (BY LG)**  
The Nexus 4 deserves being in the Top 3 list of best phones, if only the camera was at par with top 3 |
| **5 | NOKIA LUMIA 920**  
The best smartphone on the Windows Phone 8 platform, its class leading imaging performance is a bonus. |
| **6 | SONY XPERIA Z**  
1080p display, refreshing design, dust & water proof body. Camera and screen quality could be better. |
| **7 | BLACKBERRY Z10**  
Recommended for Blackberry loyalists. Offers fresh, new BB10 OS, solid hardware and a good camera. |
| **8 | HTC ONE X+**  
One of the best Android smartphone today, buy it for its performance, style and a gorgeous screen. |
| **9 | SAMSUNG GALAXY S III**  
The Galaxy S III is fast and offers some unique features to differentiate itself from the rest. |
| **10 | APPLE IPHONE 4S**  
The 4S is recommended if you do not need the larger screen and gaming performance of the iPhone 5. |
### Top 10 Budget Tablets

Our list of the Best Budget Tablets in India across various platforms. Top 10 Budget tablets are primarily based on Google Android OS. These Budget tablets are priced below Rs. 15,000. Based on data available as of 01-05-2013

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Google Nexus 7</td>
<td>Stock Android, access to the latest Google OS, Google Now and a smooth interface.</td>
</tr>
<tr>
<td>2</td>
<td>Iberry Auxus Core X2 3G</td>
<td>Great performance, an impressive display, and ability to make voice calls.</td>
</tr>
<tr>
<td>3</td>
<td>Samsung Galaxy Tab 2</td>
<td>Dual-core processor, smooth interface and the ability to make calls.</td>
</tr>
<tr>
<td>4</td>
<td>Lava E-Tab Xtron</td>
<td>The Xtron has a very capable processor, offers Jelly Bean and is well built.</td>
</tr>
<tr>
<td>5</td>
<td>Videocon VT10</td>
<td>The V10 boasts of a good battery life, 10-inch display and smooth performance.</td>
</tr>
<tr>
<td>6</td>
<td>Spice Stellar Pad</td>
<td>The Stellar Pad has loud speakers, smooth video playback, a good crisp display and long-lasting battery.</td>
</tr>
<tr>
<td>7</td>
<td>Acer Iconia B1</td>
<td>The B1 runs on Jelly Bean and offers good user experience by ensuring close to vanilla android UI.</td>
</tr>
<tr>
<td>8</td>
<td>Iberry Auxus Core X4 3G</td>
<td>The Auxus CoreX4 3G boasting of an IPS display, 6-hour battery life and a quad-core powerhouse CPU.</td>
</tr>
<tr>
<td>9</td>
<td>Wickedleak Wammy Desire</td>
<td>One of the better built 7-inch tablets running Jelly Bean, recommended for anyone on a tight budget.</td>
</tr>
</tbody>
</table>
# TOP 10 LAPTOPS


<table>
<thead>
<tr>
<th>Rank</th>
<th>Laptop Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HP Envy dv6-7206tx</td>
<td>The Envy dv6-7206tx is a very capable machine, with a great build and solid performance.</td>
</tr>
<tr>
<td>2</td>
<td>Lenovo IdeaPad Y500 (59-346619)</td>
<td>Build excellently and offering a full HD 15.6 display, the Y500 delivers great all-around performance.</td>
</tr>
<tr>
<td>3</td>
<td>Sony Vaio S Series (SVS15115FNB)</td>
<td>The Vaio S Series is powerful and slim, with brilliant battery life and a vivid display.</td>
</tr>
<tr>
<td>4</td>
<td>Lenovo IdeaPad Z500 (59-341235)</td>
<td>An excellent laptop in the Rs. 50,000 price bracket, the sleek Z500 is a very good performer.</td>
</tr>
<tr>
<td>5</td>
<td>Lenovo IdeaPad Z580</td>
<td>The IdeaPad Z580 is highly recommended for its excellent performance and build, and value price tag.</td>
</tr>
<tr>
<td>6</td>
<td>Dell Inspiron 15R Turbo</td>
<td>Offers great performance for its price, including solid gaming capabilities and overall build quality.</td>
</tr>
<tr>
<td>7</td>
<td>Acer Aspire V3-571G (33114G75MAKK)</td>
<td>Offering great build quality at its price, it delivers good system performance with gaming potential.</td>
</tr>
<tr>
<td>8</td>
<td>HP Pavilion G6-2227Tu</td>
<td>The G6-2227tu features a capable dedicated GPU, and delivers excellent performance versus price value.</td>
</tr>
<tr>
<td>9</td>
<td>HP Pavilion G6-2301AX</td>
<td>The G6-2301ax outshines its rivals in this competitive category, and is a value for money purchase.</td>
</tr>
<tr>
<td>10</td>
<td>Asus F202E-CT148H VIVOBOK</td>
<td>The HP Pavilion G6 is recommended for power users wanting quad-core based laptops with gaming GPUs</td>
</tr>
</tbody>
</table>
with an active community is that everyone will have an opinion on a tech device or technology, and detailed user reviews on anything and everything are always to be found. Dedicated threads for discussions pertaining to a product or device are a great way to research about something, sifting through information that’s been filed methodically. Don’t worry if you’re new to a tech forum, most members are always happy to help out and outmatch each other’s prowess in giving you the most comprehensive answer to your query. Just as long as you don’t get drawn into flame wars and keep a low profile, you’ll be fine.

While on your quest for thoroughly researching about a mobile device online before purchasing it, make sure you also visit reviews aggregator websites like alatest.com, where you can search for a product and find related reviews linking back to a whole host of websites from around the world, complete with a snapshot of the product’s verdict, score or rating, and of course link to the original in-depth review. Think of Alatest.com as the search index for product reviews and the site does what it claims pretty well.

Also, whenever a big product is announced by a manufacturer but it’s not yet out for purchase in the market -- think of the hype and euphoria surrounding a brand new Apple product or the announcement of a Samsung Galaxy S4, for instance -- a good tip is to create a Google alert for it. If you’ve never used the service, Google Alerts is a tremendously useful yet severely under-exploited service offered by the search engine giant which lets you track news surrounding and interesting new content around a search term of your choice. Just head over to google.co.in/alerts and enter your search query (for instance, Samsung Galaxy S4 mini), keep the default ‘Result type’ but tinker around with the ‘How often’ field, which relates to how often you’d like Google to keep you updated about the topic of your choice. Set an alert and let Google do its magic, and see how it adds a whole new dimension to your product researching skills.

Whatever you do, however, do not get swayed by ‘user reviews’ posted on shopping sites, as they’re often misleading and open to abuse. We know it’s easy to get influenced by a few consecutive positive (or negative) ‘reviews’ posted on a product page on an ecommerce website, providing the final impetus towards making or breaking a purchase. Such reviews don’t matter, as far as making an educated, well-researched product purchase is concerned -- or if they do, attach minimal importance to them in your scheme of things.
Then check all major retailers for the best deal

For better or for worse, the era of e-commerce is well and truly underway in India, and a whole generation of buyers (new and old) are flocking on to online shopping sites to purchase goods, including the latest smartphone, the greatest tablet and the sleekest new ultrabook. The stereotypical inhibitions of the quintessential Indian tech buyer -- who'd much rather touch and feel a product before purchasing it -- have been laid to rest with the recent boom in online shopping as deals and discounts have steadily moved out of electronic stores and onto online shopping destinations. So in your hunt for bagging that much-awaited product at a dream price, definitely visit some of the following online haunts.

**eBay.in:** One of the oldest online shopping destinations in India continues to be a very popular online destination for gadget shopping today as well. We’ve seen eBay.in evolve into a formidable e-marketplace where sellers (with e-shops) sell tech products and buyers lap ‘em up with much gusto. Recently the website started a dedicated deals section under the deals.ebay.in URL, and it’s a great link to visit from time to time to know the latest and hottest gadget deal on eBay. You can create an account and get alerts and mailers from the website, too.

**Flipkart.com:** Arguably the website that truly heralded the boom in online e-commerce, especially among gadget buyers, Flipkart.com quickly garnered a reputation for getting the latest and greatest smartphones at the best possible price across anywhere in India. The website has since mushroomed into a much bigger online megastore, following its early success, and continues to go strong.

**Desidime.com:** Not exactly an online shopping portal, Desidime is a deals website that aggregates and alerts you about the latest deals running at popular online shopping destinations in India. We are habituated to regularly scouring the confines of this website for gadget deals from time to time, and the deal coupons it serves work as promised. As is the case with deals and discount coupons, you can’t really predict when stores announce special discounts (apart from popular seasonal themes and holidays), but keeping track of this website will keep you up-to-date with some interesting smartphone or tablet deal.

Of course, these three websites are by no means the only places worth visiting in your quest to secure the best possible deal through an online retailer. And the online shopping phenomenon is still evolving in India. Sometimes, especially during Diwali and Christmas, we’ve seen good ol’
physical retail outlets (chains like Vijay Sales, Croma, Ezone, etc) give online shopping destinations a good run for their money, with unique discounts exclusive to their respective chains, deals that can’t be accessed online. So with the switch to shopping online for that much-awaited smartphone or tablet, don’t count out (t)rusty old electronic stores from your list just yet.
NEWS AND REVIEWS
Comprehensive news, unbiased reviews and ratings to help you make the right purchase

DOWNLOADS
Check out the latest software downloads, games for your Windows, Linux, Mac and PDA/mobiles

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VISIT NOW www.thinkdigit.com
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Glad to be a Programmer

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