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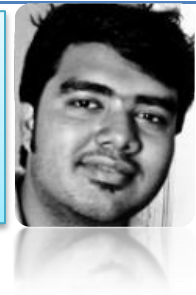
ByT3Cod3 Disclosure:

From the Editor's Desk...



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The Idea: It is basically a technical online magazine focused to publish articles achievable as technical tutorials consisting information about various developer/designer tools and their walkthroughs. The magazine will also consider review articles of various technologies. A monthly publication will archive articles provided by us and the articles mailed to KolkataNET by other people through-out the month.

Through this project, technical enthusiastic people will have a platform to share their working styles, credibility and get accelerated in their work by the information provided in the magazine. It is difficult to host UG Meets frequent enough to cope up with the pace of technical advancements and thus its more than difficult to resolute the technical interest of most of us. With the privilege to publish one's technical skills, it will expose many suppressed talented faces among us, in much greater factor.

We are a community because we want learn from each other and share our fruits with other members. And this magazine/platform is going to accelerate our community and reputations in return of our interest and co-operation.

How to contribute: Members, who find interest in this project, can send relevant articles to bty3cod3@mail.com. And they will be included it in the upcoming edition of the magazine. What we can also do is, promote ByT3CoD3, so that more people can contribute and ByT3CoD3 can be produced in a better quality for. Many of us very frequent bloggers. We can also send our latest blog posts so that it can reach all of our community members.

ByT3CoD3 is on FaceBook an Tweeter also. Please promote the project among your contacts to make its purpose successful. Like it on facebook/tweeter [page: ByT3CoD3]. ByT3CoD3 has put up a temporary website at www.byt3.co.de till it merges with the KolkataNET.

Benefits:

As the magazine is not technology specific. We can share our skills related to any platform.

Our articles will increase our reputation and also allow us to reach people experienced in the same field of work.

We will have information served by different people in different fields that is or may be relevant now or in future.

ByT3CoD3 will also generate a low color print edition so that we can easily print out the magazine for our personal archival.



REVIEWS

Fluent Interface in Java



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If you are familiar with java or any other OOP language, you must have come across codes like

```
Toast.makeText(text).setGravity(Gravity.TOP, 0, 0).setView(layout).show();
```

In the example, notice how the methods are chained one after another! Now, in a normal coding practice most of us don't create methods that can be chained like

this. We use simple data types or void return types in general practice. But this chaining representation does look very cool. Doesn't it! So HOW TO DO IT?.. There are several ways, actually. The most obvious way is.. make the return type of the methods to be the class type. And then return e.g.

See this code. test is the class name.. so the return type is test.

And returning "this".

```
public test setName(String name){  
    this.name = name;  
    return this;  
}  
  
public test setTitle(String title){  
    this.title = title;  
    return this;  
}  
  
public test setRoll(String roll){  
    this.roll = roll;  
    return this;  
}  
  
public test setEmail(String email){  
    this.email = email;  
    return this;  
}
```

Now to call from other method,

```
test test = new test();

test = test.setName("Ritaban ")
        .setTitle("Guha ")
        .setRoll("68 ")
        .setEmail("Ritaban@live.in");
```

What we also could have done is,

We could have passed the class instance through each class method calls and returned the class instance. That way the code would work in similar way but it's a bit idiotic, I would say.

```
public test setName(test test,String name){
    this.name = name;
    return test;
}

public test setTitle(test test,String title){
    this.title = title;
    return test;
}

public test setRoll(test test,String roll){
    this.roll = roll;
    return test;
}

public test setEmail(test test,String email){
    this.email = email;
    return test;
}
```

You see what I mean... 😊

```
test test = new test();

test = test.setName(test, "Ritaban ")
        .setTitle(test, "Guha ")
        .setRoll(test, "68 ")
        .setEmail(test, "Ritaban@live.in");
```

Now this Type or programming style was first displayed by Eric Evans and Martin Fowler. They named the style as fluent interface. The style makes the codes more readable and give a PRO like brushing to it.

Ready-Boost in Linux



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The idea of readyboost is simple. For machines with low RAM, whenever the data access requirements over-flood the RAM, the OS starts to pass the least probably-important data to the page files on the hard disk and loads currently required/most important/high priority data on to the RAM from the hard disk/page files. This is where the machine slows down. Activating the readyboost adds another layer in between the page files and the RAM in the data access hierarchy. Thus whenever the ram over-floods, the new data is loaded from the flash drive and the old data is passed to the flash drive. In the flash drive also data

is collected and maintained in the same manner as the RAM.

Now, Linux also uses something similar to the paging file systems called the swap partition. Swap partitions do the almost the same job that is done by the page files in the windows environment. So it is possible to create swap partition on a flash drive. As because flash drives give a higher access speed, the swap partition will be faster on the flash drive. And if we assign priority to the flash drive swap compared to the dedicated hard disk swap, the flash drive enters in to the hierarchy scheme and performs almost the same way as the readyboost concept.

Now the most important thing..... **HOW TO DO IT...** [the code is for ubuntu]

Open the terminal.

i> Plug-in the flash drive.

ii> Linux shall automount the drive. Then you have to unmounts it Sudo unmounts /media/"usbdisk"

iii> Now find the usb device in the terminal using the command Sudo df -h [it will be something like /ev/sda1 or /dev/sdb2 etc. I am considering /dev/sda1 here]

```
iv> Sudo mkswap /dev/sda1  
[creating the swap at the /dev/sda1 flash drive]
```

```
v> Sudo swapon -p 32767 /dev/sda1 [-p is to activate a partition and not a file. Anf the number 32767 is the priority number. Linux processes support a priority range of 0-32767. 0 being the min priority and 32767 being the highest]Ok.
```

The flash drive is now working as a swap partition. It's better to format the flash

drive in exfat file system [specially ext4] as the swap partition works best on that file system. To verify the swap partition being operational type the following code on terminal

```
Cat /proc/swaps
```

If the swap partition is active, then it will be shown on the output list along with the

Now I did mention that the swap technique will work almost the same way as readyboost.

Well, Almost.

In windows we were creating a page file which is comparable to a swap file, not a swap partition. Swap files are very flexible but vulnerable. If deleted accidentally, data could be lost or even the OS can get corrupted. Swap partitions can't be modulated while being used. Thus the data cannot be affected. And in some cases the access speed in swap files is

dedicated hard drive swap partition(s). To turn the "ReadyBoost" off on the linux [Ubuntu] type this code on terminal

```
Sudo swapoff /dev/sda1 [/dev/sda1 here is the flashdrive as detected in step 2.]
```

better than swap partitions. In linux, we are creating a swap partition on the flash drive. We shouldn't create a swap file as because linux will not prevent us from deleting the file due to its high flexibility. So the speed advancement in linux may not be as promising as in windows. But, yeah it still works..

Multi Core Architecture Simplified



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I have come across many people who just can't figure out exactly how is the multicore architecture better than the single core. A more important question among them is, how is a single core 2.55GHz single core [e.g. pentium 4] processor is not better than a 1.6GHz Dual-core, Core2Duo etc. processors.

Well it's certainly a very strong point that, the clock frequency ultimately decides the processor speed. Higher the clock frequency, better the processor performance. But still we moved to the multicore architecture even if the clock frequency is not necessarily greater. WHY?

The reason is simple.

The higher the frequency, the faster the processor.

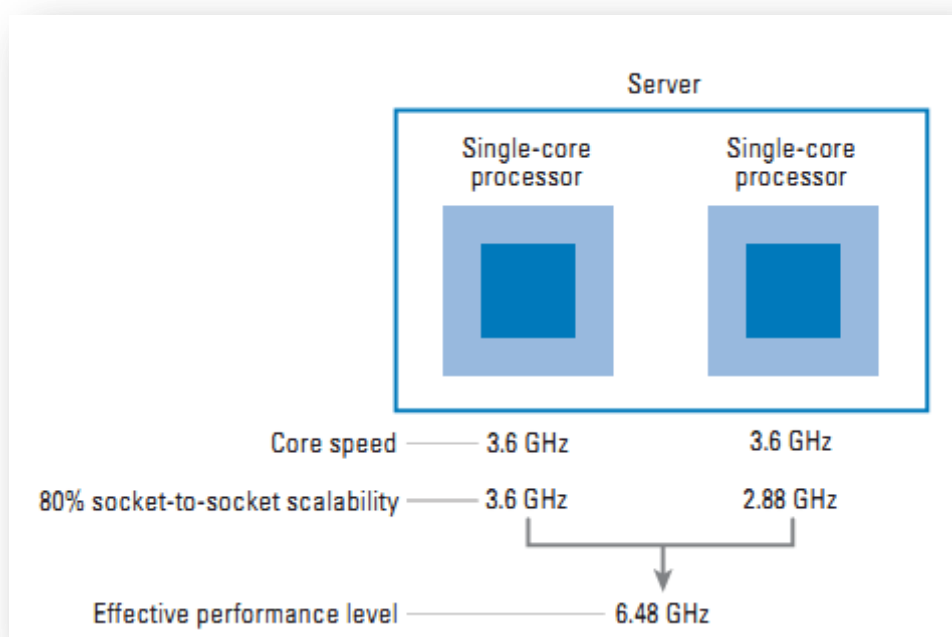
The faster the processor, greater the data speed.

The greater the data speed, more the heat generated.

As the generation of fabrication technology advances, the transistors become smaller the current processors are built over 32nm ($\mu=32\text{nm}$ > Sandy bridge & $\lambda=32\text{nm}$ > in R&D) fabrication technology. The smaller the transistor get, the less power is required and the less heat they can sustain.

So, we can't just keep increasing the clock frequency. As the generation of fabrication advances, the transistor density increases in the processor. The processors become smarter and more capable. But the supported clock frequency may not increase relatively.

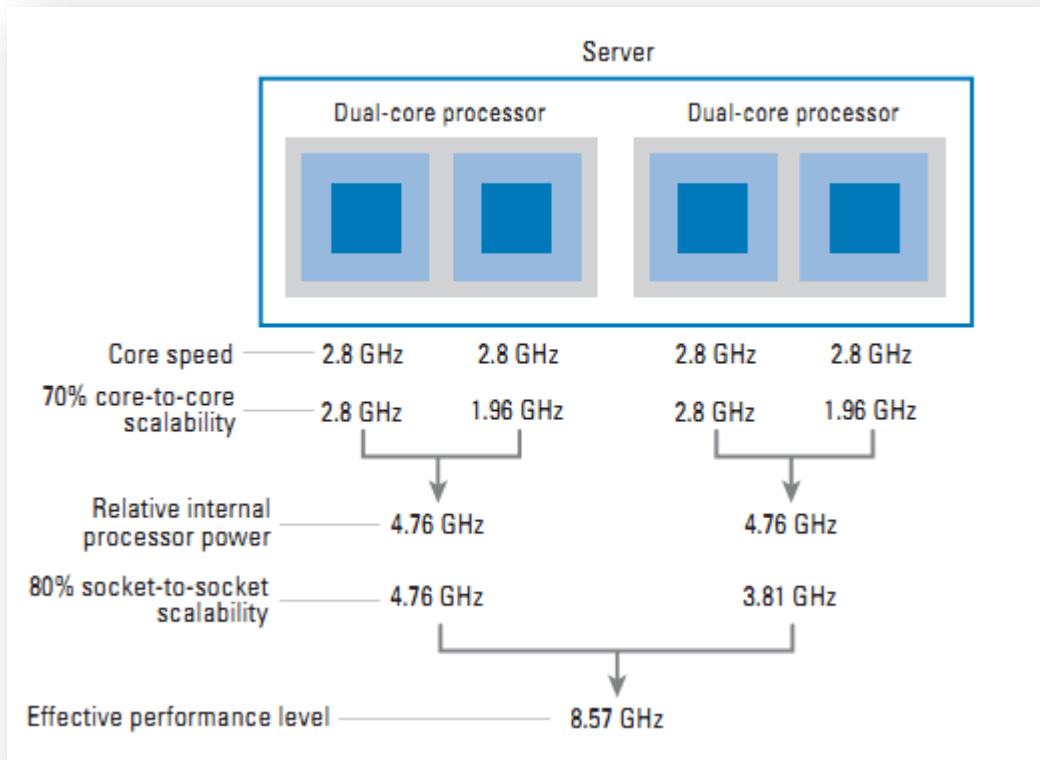
So far, it is clear that processor clock frequency can't just be increased to achieve higher efficiency. Now, comes the multicore architecture. The most common idea about multicore processors is that, they consist of multiple processors cores in the same board, thus gives twice the performance than single core. Well it's not entirely wrong. Lets take a Dual Core processor for understanding. In a Dual Core processor, there are 2 cores embedded on the single core environment. The cores share the same BUS system. Thus if one core performs at its 100% the other can at max achieve 80% of its processing capability (as per the processor architecture).



This is an example shown here. In the environment, there are 2 cores each of 3.6GHz core speed, sharing the same bus system. The BUS structure is optimized to a level to achieve 80% of max performance while the other core delivers 100%.

If we increase the number of cores, the effective performance will be relatively lesser than an architecture with lesser number of cores, though the overall performance increases.

Another example??



Consider a system with 4 cores. A Core 2 Duo processor. In this type of architecture 2 dual core processors are scaled together to give a 4 core based processor system. The dual cores are designed in the fashion described earlier. Here dual core fabrication is just a part of the process. The dual cores achieved 80% SOSS, resulting in an 180% processing power compared to a single core. The 2 cores are embedded together in a single processor architecture. Here the SOSS remains 80% but the COCS is 70% for both the dual cores. If the number of cores are increased under the same architecture, with each layer of scalability the efficiency will get relatively reduced. Standard Core2 Quad systems were built in an architecture similar to Core 2 Duo, but the Xeon Quad cores are designed in a more efficient way.

So this was the general architecture of multicore environment processors. Though one must be aware that, multi core is not all that makes the new generation processors so much efficient.

Instant Boot



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At the beginning when I used to get so amazed to see that “Loading Windows” screen [1st was introduced to windows later other OSs]. After an year or 2, I used to get amazed to realize that the behind that boring screen so many drivers were being loaded, so many things are happening behind the screen. And finally the OS logon screen appeared. WOW. And now, I feel like throwing my PC if takes to much time to boot. “60 second to boot!! I rather keep in on”. :PMany people does keep their PCs on, as because the boot time is too much for them. Power isn’t

cheap. IF every one can save 1Watt/month, that could serve someone or few with no power at all. Apart from the Nobel thoughts, keeping the PC ON, reduces the device lifetime and there are other side effects also. So the Idea of Instant boot was in the dreams for a long time. And voila, Microsoft hints for an 8 second boot Windows 8. With Intel’s SandyBridge processors, It may be possible to provide boot time less that 8sec. Microsoft didn’t promise anything but they are working on the feature called “Instant ON”.

While this stays on the drawing board, there are a few products in the cloud that could give people a taste of the “POOFFF!!! __ON” action. A popular tool called SplashTop/QuickWeb, which can be installed parallel to the standard OS in a PC and it will integrate with the BIOS and will allow a 4 sec boot to that app. SplashTop/QuickWeb app. has the facility of Browsing, Listening to music ,viewing Photo Gallery, check emails Etc. Now this is a very promising tool. Its very useful to access the Websites and listen to music without waiting for the boot time. IF we want to get in to the main OS, there is a button on the app to boot into the OS.

Yeaah.. that’s awesome.. But that doesn’t comply to the challenge of instant booting to the Main OS with full features...ASRock came up with some thing called “Instant BOOT”. This brand new technology allows to boot supported motherboards within a blink to the fully functional OS. It not only saves energy but helps system running speed. The function is effective iff u hav a single user account with no password to

their system. The boot time will depend on the H/W config.

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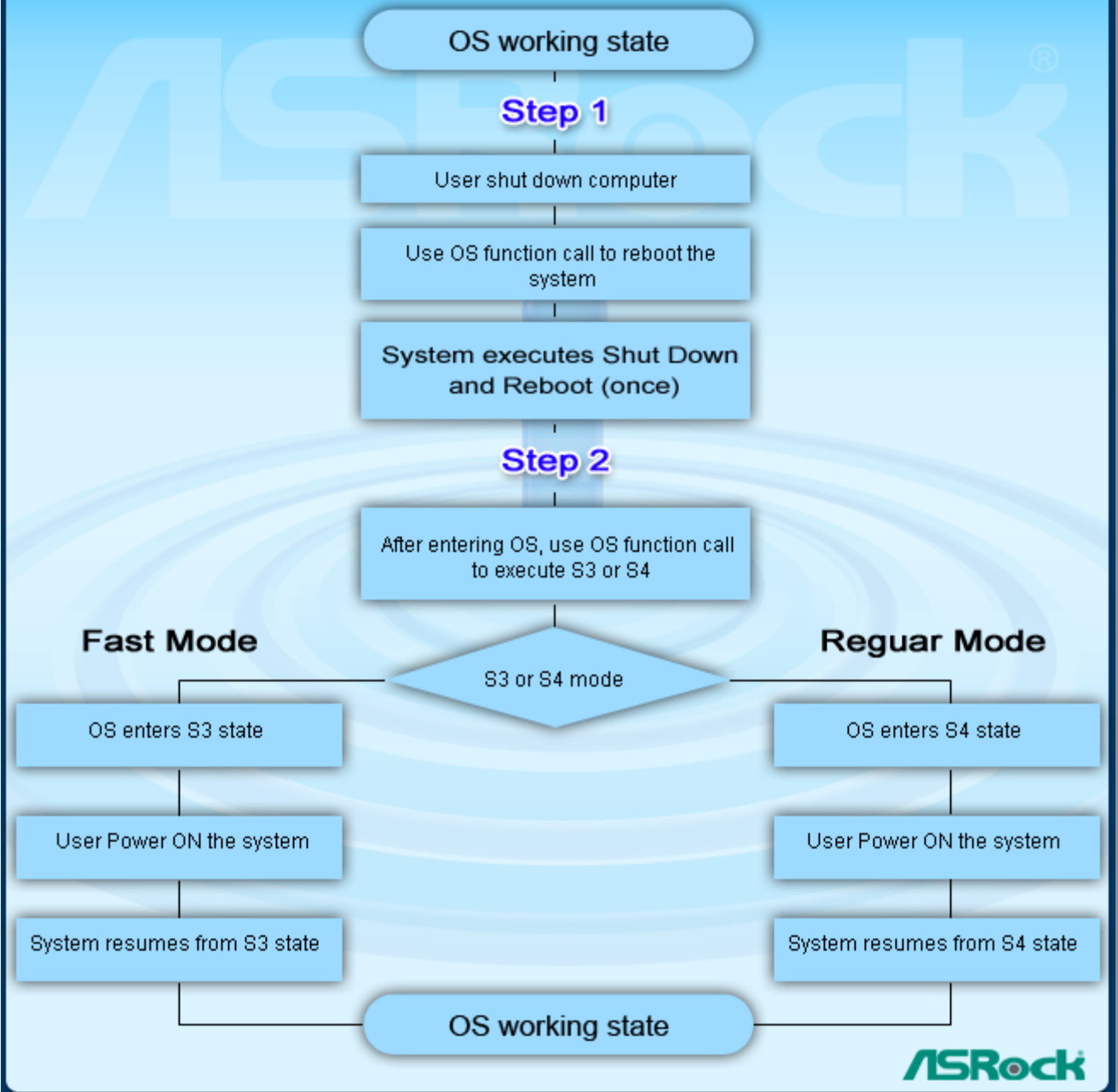
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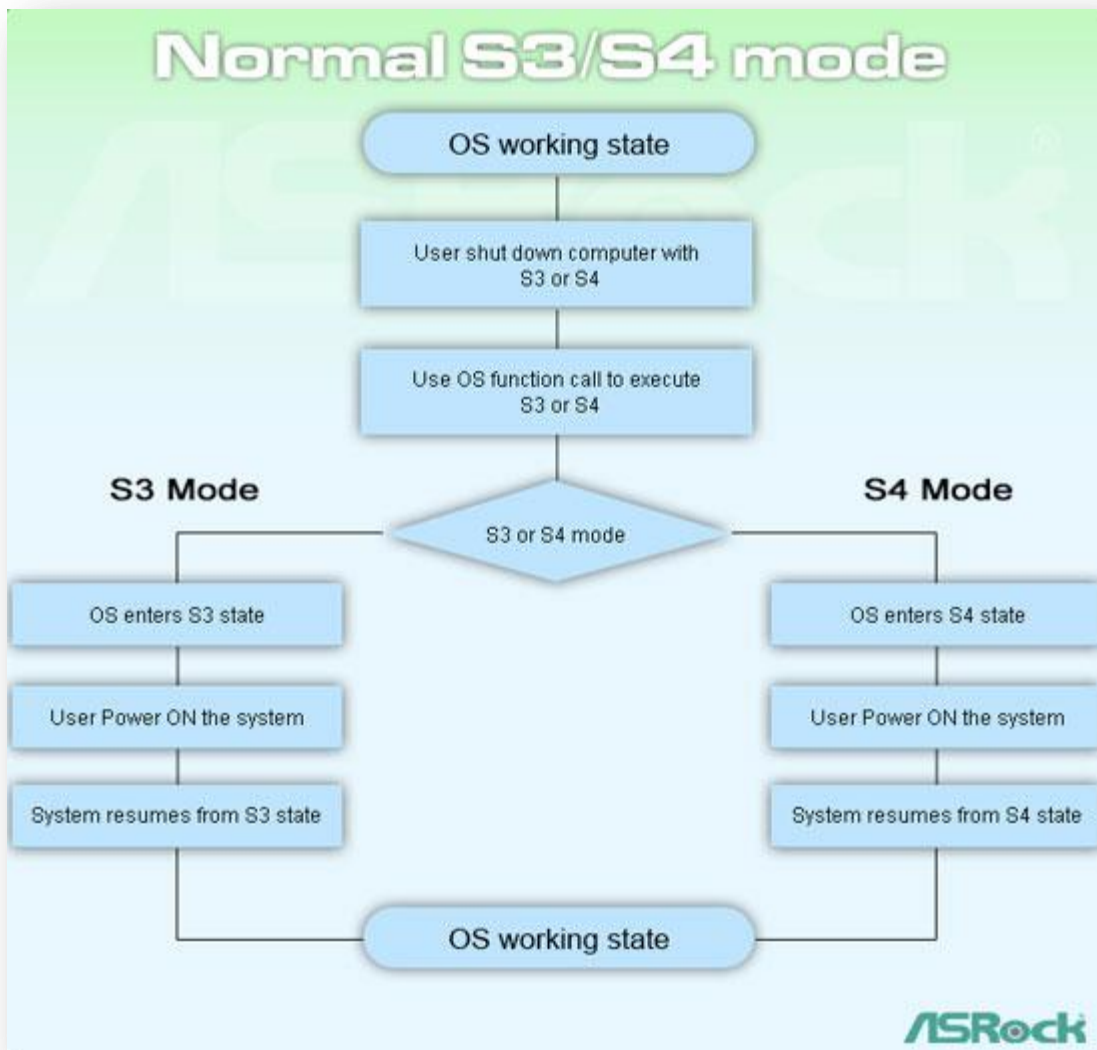
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saves energy but helps system running speed. The function is effective iff u hav a single user account with no password to their system. The boot time will depend on the H/W config. The following block diagrams taken from the ASRock site, explain the process:

ASRock Instant Boot





The System Power States :

The states S1,S2,S3,S4 are the sleeping states where the system can't perform any computational task. While the S5 state is the complete shutdown state. A sleeping state allows to retain memory state of the system either in hardware or in some other storage media. Devices may be able to wake up on occurrence of certain incidents. e.g. call to the modem, alarm on the mobile phone etc. with the increase of the sleep state index the system goes into deeper sleep starting from shutdown of processor clocks(S1) to loss of total system hardware

context(S4). During the Hibernate method the memory is written to a hibernate file. During hibernate, all sort of power consumption is off. The operating system context is retained in a hibernate file. Before restart, the system loads the hibernate file and reads for the jump location and returns to the previous state called the prehibernation location. If AC power is lost, the system can't wake up from S1,S2,S3 states and requires to boot up to S0 state. But S4 state retains the memory due to the hibernate file

So there u have it.. if your mother board is Instant boot enabled go for it. Or if you hav a new ASRock/ASUS motherboard, download the Instant boot tool from the ASUS website. Otherwise.. hang out with the QuickWeb or SplashTop.

»Pro and Cons of various shut down modes
 From this sum up table, we can find that ASRock Instant Boot not only excels in the Boot Up speed (3~4 sec.), it also provides data safety, clean OS, and saves the most power energy.

	No Shut Down	Traditional boot up	S3	S4	Instant Boot	
					Fast Mode	Regular
Boot Up Time	Best 	Worse 50~60 sec	Best 3~4 sec	Good 20~22 sec	Best 3~4 sec	Go 20~22 sec
Data Security (AC Power Off accidently)	Worse Data Lost	Best Safe!	Worse Data Lost	Best Safe!	Best Safe!	Be Safe!
Cleanliness of OS	Fair Accumulated garbage data	Best Clean	Fair Accumulated garbage data	Fair Accumulated garbage data	Best Clean	Be Cle
Power Consumption (Light loading)	Worse 60W~-100W	Best 1W~3W	Best 1W~3W	Best 1W~3W	Best 1W~3W	Be 1W~

Windows 8 Developer Preview Customization Trick



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With a Hit over million, on the very 1st day of the launch of the Windows Developer Preview, WDP is probably the most Hot Topic in the market. Yet, a good size of crowd is disappointed with some of its new style statements. In aid to solution, this document will help improve the look & feel of the next windows, in the manner you desire.

1. There are already tools available to change the theme color and the Metro UI background. If you are not interested to get down dirty and get a flavor of full control of the UI style, I suggest you go for these tools.

BluePoison, Win8StartTweaker etc.

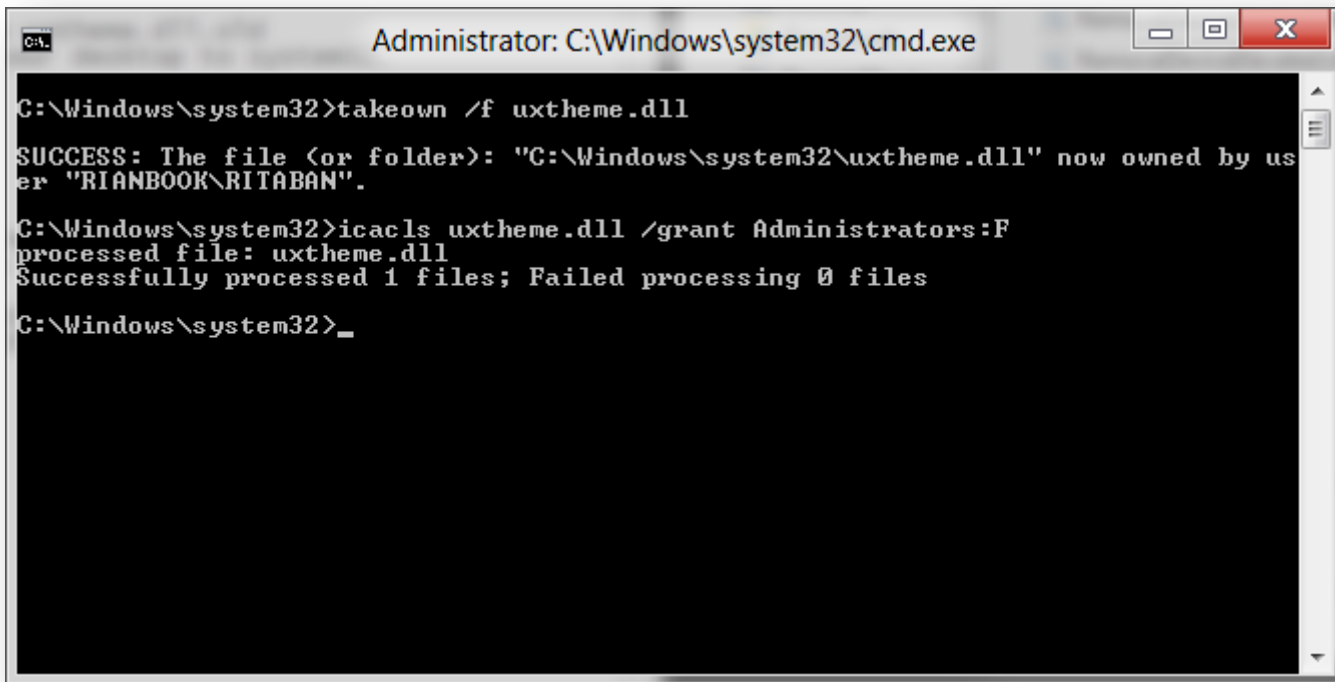
2. And here's the dirty method to get stuff customized.

i. Download a hex editor. Anyone you like. E.g. HeXEdit, HxD etc. and install it.

ii. Open the command prompt in admin mode.

iii. Go to windows/System32/ and type `takedown /f uxtheme.dll`

iv. Now type `icacls uxtheme.dll /grant Administrators:F`

A screenshot of a Windows command prompt window titled "Administrator: C:\Windows\system32\cmd.exe". The window has a black background and white text. The text shows the following commands and their outputs:

```
C:\Windows\system32>takeown /f uxtheme.dll
SUCCESS: The file (or folder): "C:\Windows\system32\uxtheme.dll" now owned by user "RIANBOOK\RITABAN".
C:\Windows\system32>icacls uxtheme.dll /grant Administrators:F
processed file: uxtheme.dll
Successfully processed 1 files; Failed processing 0 files
C:\Windows\system32>_
```

- v. Now, copy the uxtheme.dll file to desktop or some other convenient place to edit.
- vi. Open up the file with your hex editor.
- vii. Here is the 32Bit Edit Info Tables.

Modification Effect	Address 32Bit	Default Value	Address 64Bit	Default Value	Replace With
Main Background Color (UI center pane)	0x34F70-0x34F73	0E6D38FF	0x96F30-0x96F33	0E6D38FF	Hex RGBA COLOR
SideBar Color	0x3501C-0x350F				
	0x34FC4-0x34FC7	008845FF	0x96F84-0x96F87	008845FF	SATURATED
	0x35020-0x35023		0x96FE0-0x96FE3		RGBA
	0x35024-0x35027		0x96FE4-0x96FE7		
	0x35064-0x35067		0x97024-0x97027		
	0x35070-0x35073		0x97030-0x97033		
List item hover Color	0x34FD4-0x34FD7	47A671FF	0x96F94-0x96F97	47A671FF	Desaturated
	0x35028-0x3502B		0x96FE8-0x96FEB		RGBA
	0x35040-0x35043		0x97000-0x97003		
	0x35060-0x35063		0x97020-0x97023		
	0x3506C-0x3506F		0x9702C-0x9702F		
Selected Item Color	0x34FC0-0x34FCF	10A51FF	0x96F8C-0x96F8F	10A51FF	Saturated
	0x35030-0x35033		0x96FF0-0x96FF3		RGBA
	0x35038-0x3503B		0x96FF8-0x96FFB		
	0x3503C-0x3503F		0x96FFC-0x96FFF		
	0x35044-0x35047		0x97004-0x97007		
	0x35048-0x3504B		0x97008-0x9700B		
[Thanks to Christ23NT]	0x3504C-0x3504F		0x9700C-0x9700F		
	0x35050-0x35053		0x97010-0x97013		
	0x35054-0x35057		0x97014-0x97017		
	0x35058-0x3505B		0x97018-0x9701B		
	0x3505C-0x3505F		0x9701C-0x9701F		
	0x35068-0x3506B		0x97028-0x9702B		
	0x35074-0x35077		0x97034-0x97037		
	0x35078-0x3507B		0x97038-0x9703B		
	0x3507C-0x3507F		0x9703C-0x9703F		
List item hover color for icons	0x34FD0-0x34FD3	17E574FF	0x96F90-0x96F93	17E574FF	Saturated Light
					RGBA
Tiles Background	0x34F74-0x34F77	179348FF	0x96F34-0x96F37	179348FF	Saturated
					RGBA
Tiles Font	0x34F78-0x34F7B	AFFD9FF	0x96F38-0x96F3B	AFFD9FF	Foreground
Mini Tiles	0x34F7C-0x34F7F	0C6936FF	0x96F3C-0x96F3F	0C6936FF	Saturated
					RGBA

viii. For the RGBA values, use the hex code for the color in red-green-blue format and use the alpha to set transparency.

ix. Backup the uxtheme.dll in the System32 folder and copy the modified one there..

After reboot the changes will be effective. If anything goes wrong, press F8 at boot time and go to

Troubleshoot > Advanced Options > Command Prompt.

Type the following commands,

```
ren C:\windows\System32\uxtheme.dll uxtheme.dl.blabla
```

```
ren C:\Windows\System32\uxtheme.dll.old uxtheme.dll [here uxtheme.dll.old is the backup file]
```

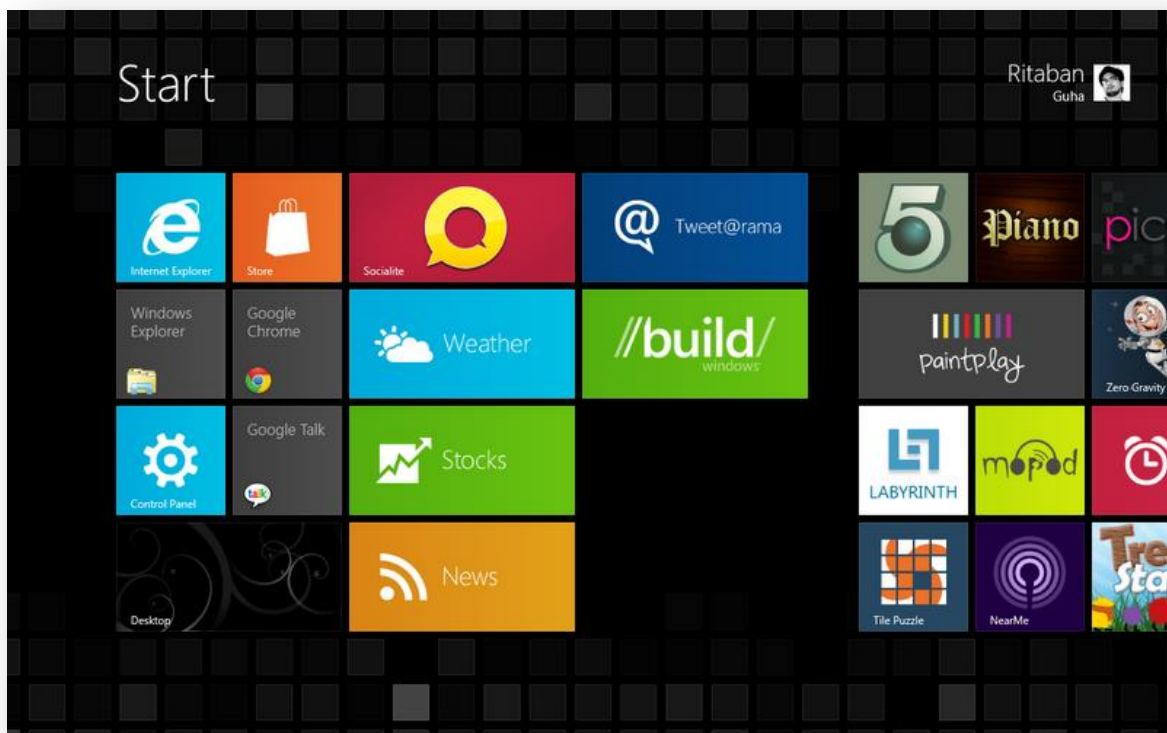
3. Now, for the background wallpaper. You can use the tools mentioned above to change the UI background. But you need to first create your choice of custom background.

The metro UI background is not a simple wallpaper. If you just apply any wallpaper, the tile holding panel will split the image in 2. And you won't get a full screen coverage

In order to make an image as a background,

- a. take a workspace of twice the height that your screen size, in photoshop.
- b. Take the image and split it in 2 halves. Vertically.
- c. Place the upper image to the upper side of the workspace and the lower half to the lower side of the workspace.
- d. Now, your image must match to the screen's resolution, otherwise when you apply this image there will be little gap on the top or the image will get squeezed near the tile holding layer's edge. It's a matter of practice and patience till u get used to this editing.. once you apply the image, after a restart your Metro Ui background will be modified.
- e. In most cases, you wont find enough time to go editing images, so try out the default available customizations with tools, I mentioned earlier.

Check out my UI...



4G Technology



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ByT3CoD3 Editor

In [telecommunications](#), **4G** is the fourth generation of [cellular wireless](#) standards. It is a successor to the [3G](#) and [2G](#) families of standards. In 2009, the [ITU-R](#) organization specified the [IMT-Advanced](#) (International Mobile Telecommunications Advanced)

requirements for 4G standards, setting peak speed requirements for 4G service at 100 [Mbit/s](#) for high mobility communication (such as from trains and cars) and 1 [Gbit/s](#) for low mobility communication (such as pedestrians and stationary users).

One of the key technologies for 4G and beyond is called "Open Wireless Architecture (OWA)" supporting multiple wireless air interfaces in an open architecture platform.

A 4G system is expected to provide a comprehensive and secure all-[IP](#) based [mobile broadband](#) solution to laptop computer [wireless modems](#), [smartphones](#), and other mobile devices. [Facilities](#) such as [ultra-broadband](#) Internet access, [IP telephony](#), gaming services, and streamed multimedia may be provided to users.

[IMT-Advanced](#) compliant versions of LTE and WiMAX are under development and called "[LTE Advanced](#)" and "[WirelessMAN-Advanced](#)" respectively. ITU has decided that LTE Advanced and WirelessMAN-Advanced should be accorded the official designation of IMT-Advanced. On December 6, 2010, ITU recognized that current versions of LTE, WiMax and other evolved 3G technologies that do not fulfill "IMT-Advanced" requirements could nevertheless be considered "4G", provided they represent forerunners to IMT-

Advanced and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed."^[2]

As seen below, in all suggestions for 4G, the [CDMA spread spectrum](#) radio technology used in 3G systems and [IS-95](#) is abandoned and replaced by [OFDMA](#) and other [frequency-domain equalization](#) schemes. This is combined with [MIMO](#) (Multiple In Multiple Out), e.g., multiple antennas, [dynamic channel allocation](#) and [channel-dependent scheduling](#).

4G HARDWARE

Ultra Wide Band Networks

Ultra Wideband technology, or UWB, is an advanced transmission technology that can be used in the implementation of a 4G network. The secret to UWB is that it is typically detected as noise. This highly specific kind of noise does not cause interference with current radio frequency devices, but can be decoded by another device that recognizes UWB and can reassemble it back into a signal. Since the signal is disguised as noise, it can use any part of the frequency spectrum, which means that it can use frequencies that are currently in use by other radio frequency devices (Cravotta).

An Ultra Wideband device works by emitting a series of short, low powered electrical pulses that are not directed at one particular frequency but rather are spread across the entire spectrum (Butcher). Ultra Wideband uses a frequency of between 3.1 to 10.6 GHz.

The pulse can be called "shaped noise" because it is not flat, but curves across the spectrum. On the other hand, actual noise would look the same across a range of frequencies — it has no shape. For this reason, regular noise that may have the same frequency as the

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Figure : Switched Beam Antenna

pulse itself does not cancel out the pulse. Interference would have to spread across the spectrum uniformly to obscure the pulse. UWB provides greater bandwidth — as much as 60 megabits per second, which is 6 times faster than today’s wireless networks. It also uses significantly less power, since it transmits

pulses instead of a continuous signal. UWB uses all frequencies from high to low, thereby passing through objects like the sea or layers of rock. Nevertheless, because of the weakness of the UWB signal, special antennas are needed to tune and aim the signal.

SMART ANTENNAS

Multiple “smart antennas” can be employed to help find, tune, and turn up signal information. Since the antennas can both “listen” and “talk,” a smart antenna can send signals back in the same direction that they came from. This means that the antenna system cannot only hear many times louder, but can also respond more loudly and directly as well (ArrayComm 2003).

There are two types of smart antennas: Switched Beam Antennas have fixed beams of transmission, and can switch from one predefined beam to another when the user with the phone moves throughout the sector Adaptive Array Antennas represent the most advanced smart antenna

approach to date using a variety of new signal processing algorithms to locate and track the user, minimize interference, and maximize intended signal reception (ArrayComm 2003).

Smart antennas can thereby:

- Optimize available power
- Increase base station range and coverage
- Reuse available spectrum
- Increase bandwidth
- Lengthen battery life of wireless devices

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Figure : Adaptive Array Antenna

Although UWB and smart antenna technology may play a large role in a 4G system, advanced software will be needed to process data on both the sending and receiving side. This software should be flexible, as the future wireless world will likely be a heterogeneous mix of technologies.

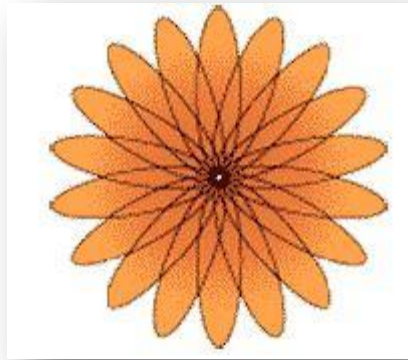


Fig: Switched Beam Antenna

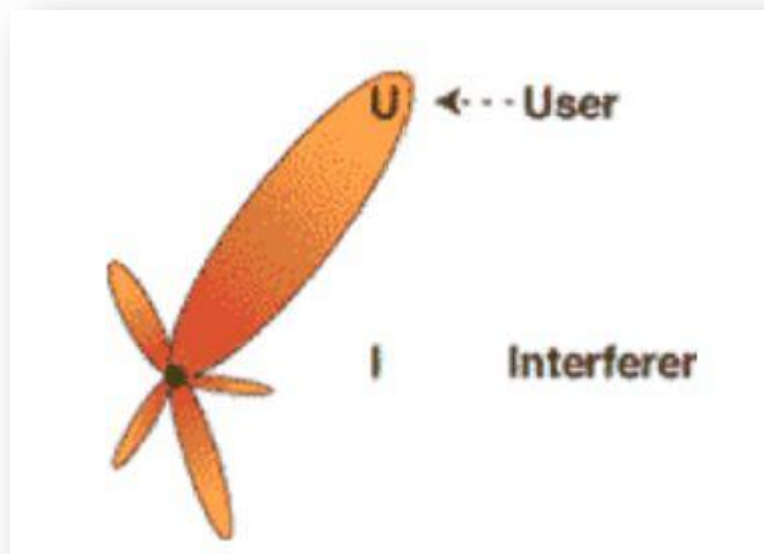


Fig: Adaptive Array Antenna

4G SOFTWARE

4G will likely become a unification of different wireless networks, including wireless LAN

technologies (e.g. IEEE 802.11), public cellular networks (2.5G, 3G), and even personal area

networks. Under this umbrella, 4G needs to support a wide range of mobile devices that can roam across different types of networks (Cefriel). These devices would have to support different networks, meaning that one device would have to have the capability of working on different networks. One solution to this “multi-network functional device” is a software defined radio.

6.1 Software Defined Radio

A software defined radio is one that can be configured to any radio or frequency standard through the use of software. For example, if one was a subscriber of Sprint and moved into an area where Sprint did not have service, but Cingular did, the phone would automatically switch from operating on a CDMA frequency to a TDMA frequency. In addition, if a new standard were to be created, the phone would be able to support that new standard with a simple software update. With current phones, this is impossible. A software defined radio in the context of 4G would be able to work on different broadband networks and would be able to transfer to another network seamlessly while traveling outside of the user’s home network.

A software defined radio’s best advantage is its great flexibility to be programmed for emerging wireless standards. It can be dynamically updated with new software without any

changes in hardware and infrastructure. Roaming can be an issue with different standards, but with a software defined radio, users can just download the interface upon entering new territory, or the software could just download automatically (Wang 2001). Of course, in order to be able to download software at any location, the data must be formatted to some standard. This is the job of the packet layer, which will split the data into small “packets.”

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6.2 Packet Layer

The packet layer is a layer of abstraction that separates the data being transmitted from the way that it is being transmitted. The Internet relies on packets to move files, pictures, video, and other information over the same hardware. Without a packet layer, there would need to be a separate connection on each computer for each type of information and a separate network with separate routing equipment to move that information around. Packets follow rules for how they are formatted; as long they follow these rules, they can be any size and contain any kind of information, carrying this information from any device on the network to another.

Currently, there is little fault tolerance built into cellular systems. If a little bit of the voice information is garbled or lost in a transfer between locations, or if interference from

other devices somehow affects the transmission, there is nothing that can be done about it. Even though the loss is usually negligible, it still can cause major problems with sensitive

Packets

. Advantages

There are many advantages of packets and very few disadvantages. Packets are a proven method to transfer information. Packets are:

More Secure Packets are inherently more secure for a variety of reasons:

- A predictable algorithm does not split packets — they can be of any size and contain any amount of data. Packets can also travel across the network right after each other or separated by packets from other devices; they can all take the same route over networks or each take a different route.

- The data in packets can be encrypted using conventional data encryption methods.

There are many ways to encrypt data, including ROT-13, PGP, and RSA; the information in a packet can be encoded using any one of them, because a packet doesn't care what kind of data it carries. Within the same packet, no matter how the data segment is encrypted, the packet will still get from one place to the other in the same way, only requiring that the receiving device know how to decrypt the data.

devices and can garble voice information to a point where it is unintelligible. All of these problems contribute to a low Quality of Service (QoS).

- There is no simple way to reconstruct data from packets without being the intended recipient. Given that packets can take any route to their destination, it is usually hard to piece them together without actually being at their intended destination. There are tools to scan packets from networks; however, with the volume of packets that networks receive and the volume of packets per each communication, it would take a large amount of storage and processing power to effectively “sniff” a packet communication, especially if the packets were encrypted. More Flexible Current technologies require a direct path from one end of a communication to the other. This limits flexibility of the current network; it is more like a large number of direct communication paths than a network. When something happens to the path in the current system, information is lost, or the connection is terminated (e.g. a dropped call). Packets only require that there is an origin, a destination, and at least

one route between them. If something happens to one of the routes that a packet is using, the routing equipment uses information in the packet to find out where it is supposed to go and gives it an alternate route accordingly. Whether the problem with the network is an outage or a slowdown, the combination of the data in the packet and the routing equipment lead to the packet getting where it needs to go as quickly as possible.

More Reliable Packets know general things about the information they contain and can be checked for errors at their destination. Error correction data is encoded in the last part of the packet, so if the transmission garbles even one bit of the information, the receiving device will know and ask for the data to be retransmitted. Packets are also numbered so that if one goes missing, the device on the receiving end will know that something has gone wrong and can request that the packet(s) in question be sent again. In addition, when something does go wrong, the rest of the packets will find a way around the problem, requiring that only the few lost during the actual instant of the problem will need to be resent.

Proven Technology Packets are the underlying technology in essentially all data based communication. Since the beginning of the Internet over 30 years ago, packets have been used for all data transmission. Technologies have evolved to ensure an almost

100% QoS for packet transmission across a network.

Easier to Standardize Current technologies use a variety of methods to break up voice communication into pieces. None of these are compatible with each other. Packets, however, are extremely compatible with various devices. They can carry different types of information and be different sizes, but still have the same basic makeup to travel over any network using any of the methods of transmission. Essentially, this enables different technologies to be used to handle the same fundamental information (Howstuffworks.com). An example of the format of a packet carrying 896 bits of actual

information can be seen in Figure **[Packet with 896-bit payload]**: The “Protocol” section would contain whatever information was needed to explain what type of data was encoded; in the case of voice

using Voice over IP (VoIP), it would read: H.323 (Protocols.com).

Extensible As shown by the growth of the Internet over the past few years, the capacity of packets is expandable. They have moved from carrying short text messages to carrying video, audio, and other huge types of data. As long as the capacity of the transmitter is large enough, a packet can carry any size of information, or a large number of packets can be sent carrying information cut up into little pieces. As long as a packet obeys the standard for how to start and end, any data of any size can be encoded inside of it; the transmission hardware will not know the difference.

Header	Sender's IP address Receiver's IP address Protocol Packet number	96 bits
Payload	Data	896 bits
Trailer	Data to show end of packet Error correction	32 bits

Fig : Packet with 896-bit payload

Disadvantages

Unfortunately, to use packet, all cellular hardware will need to be upgraded or replaced.

Consumers will be required to purchase new phones, and providers will need to install new equipment in towers. Essentially, the communication system will need to be rebuilt from the ground up, running off of data packets instead of voice information. However, given the current pace of technological development, most consumers buy new phones every six to twelve months, and providers are constantly rolling out new equipment to either meet

expanding demand or to provide new or high-end services. All networks will be compatible once the switch is completed, eliminating roaming and areas where only one type of phone is supported. Because of this natural pace of hardware replacement, a mandated upgrade in a reasonable timeframe should not incur undue additional costs on cellular companies or consumers. The technological disadvantage of using packets is not really a disadvantage, but more of an obstacle to overcome. As the voice and data networks are merged, there will suddenly be

millions of new devices on the data network. This will require either rethinking the address

space for the entire Internet or using separate address spaces for the wireless and existing networks.

IMPLEMENTATION OF PACKETS

Current System: IPv4

Currently, the Internet uses the Internet Protocol version 4 (IPv4) to locate devices. IPv4 uses an address in the format of xxx.xxx.xxx.xxx where each set of three digits can range from 0 to 255 (e.g 130.207.44.251). Though combinations are reserved, but this address format allows for approximately 4.2 billion unique addresses. Almost all IP addresses using IPv4 have been assigned, and given the number of new devices being connected to the Internet every day, space is running out. As people begin to connect refrigerators, cars, and phones to the Internet, a larger address space will be needed.

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6.4.2 Recommended System: IPv6

The next generation addressing system uses the Internet Protocol version 6 (IPv6) to locate devices. IPv6 has a much larger address space. Its addresses take the form x:x:x:x:x:x:x where each x is the hexadecimal value that makes up one eighth of the address. An example

of this is:

FEDC:BA98:7654:3210:FEDC:BA98:7654:3210 (The Internet Engineering Task Force Network Working Group). Using this address format, there is room for approximately 3.40×10^{38} unique addresses. This is approximately 8.05×10^{28} times as large as the IPv4 address space and should have room for all wired and wireless devices, as well as room for all of the foreseeable expansion in several lifetimes. There are enough addresses for every phone to have a unique address. Thus, phone in the future can use VoIP over the Internet instead of continuing to use their existing network.

6.4.3 Voice over IP (VoIP)

Voice over IP is the current standard for voice communication over data networks. Several standards already exist for VoIP, the primary one being International Multimedia Telecommunications Consortium standard H.323. VoIP is already in use in many offices to replace

PBX-based systems and by several companies that offer cheap long distance phone calls over the Internet, such as Net2Phone and Go2Call. VoIP allows for flexibility the same way that data packets do; as far as the network is concerned, VoIP packets are the same as any other packet. They can travel over any equipment that supports packet-based communication and they receive all of the error correction and other benefits that packets receive. There are many interconnects between the data Internet and the phone network, so not only can VoIP customers communicate with each other, they can also communicate with users of the old telephone system.

ENCRYPTION

Two encryption/decryption techniques are commonly used: asymmetric and symmetric encryption.

Symmetric encryption is the more traditional form, where both sides agree on a system of encrypting and decrypting messages — the reverse of the encryption algorithm is the decryption algorithm. Modern symmetric encryption algorithms are generic and use a key to vary the algorithm. Thus, two sides can settle on a specific key to use for their

One other thing that VoIP allows is slow transition from direct, connection based communication to VoIP communication. Backbones can be replaced, allowing old-style telephone users to connect to their central office (CO) the same way. However, the CO will then connect to an IPv6 Internet backbone, which will then connect to the destination CO. To the end user, there will not seem to be any difference, but the communication will occur primarily over a packet-based system, yielding all of the benefits of packets, outside of the short connections between either end of the communication and their CO. Of course, in order to keep curious users from listening in by “sniffing,” all data, including voice, should be encrypted while in transit.

communications. The problem then is the key transportation problem: How do both sides get the key without a third party intercepting it? If an unauthorized user receives the key, then he too can decrypt the messages.

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The solution to this problem is asymmetric encryption. In symmetric encryption, the encryption and decryption algorithms are inverses, but the key is the same. In asymmetric encryption, the keys are inverses, but the algorithm is the same. The trick is that one

cannot infer the value of one key by using the other. In an asymmetric (also called publickey) system, an end user makes one key public and keeps the other private. Then all parties know the algorithm and the public key. If any party wishes to communicate with the users, that party can encrypt the message using the public key, and only the user (with her private key) can decrypt the message. Moreover, the user can prove that she generated a message by encrypting it with her private key. If the encrypted message makes sense to other parties when decrypted with the public key, then those parties know that the user

must have generated that message (Dankers, Garefalakis, Schaffelhofer, and Wright 2002, 181).

Situations exist in cellular wireless systems where either symmetric or asymmetric keys are particularly useful. Asymmetric keys are useful for one-time connections, especially when

used to create a symmetric key for an extended connection. Meanwhile, symmetric keys are smaller and faster, and thus are strongly preferred if key transportation is not a problem.

An excellent example of this is the GSM system's subscriber information card placed into

each phone. The card holds a unique symmetric key for each subscriber.

FLEXIBILITY

In reality, however, the usage of different encryption schemes depends on many factors, including network data flow design. Thus, it is important that the encryption method be able to change when other determining factors change. Al-Muhtadi, Mickunas, and Campbell of University of Illinois at Urbana-Champaign showed great foresight in admitting that "existing security schemes in 2G and 3G systems are inadequate, since there is greater demand to provide a more flexible, reconfigurable, and scalable security mechanism as fast

as mobile hosts are evolving into full-fledged IP-enabled devices" (Al-Muhtadi, Mickunas, and Campbell 2002, 60).

Unfortunately, IPv6 can only protect data in transmission. Individual applications may contain flaws in the processing of data, thereby opening security holes. These holes may

be remotely exploited, allowing the security of the entire mobile device to be compromised.

Thus, any wireless device should provide a process for updating the application software as security holes are discovered and fixed.

ANTI-VIRUS

As wireless devices become more powerful, they will begin to exhibit the same security weaknesses as any other computer. For example, wireless devices may fall victim to trojans or become corrupt with viruses. Therefore, any new wireless handheld device should incorporate antivirus software. This software should scan all e-mail and files entering through any port (e.g. Internet, beaming, or synchronizing), prompting the user to remove suspicious software in the process. The antivirus software should also allow secure, remote updates of the scanning software in order to keep up with the latest viruses



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