

# To Study the Energy Efficient Departments of Existing Attributes for Next Generation Network Infrastructures

Gowher Mushtaq, Shashank Singh, Neeraj Kumar Tiwari

**Abstract**— *The Survey on energy-efficient Green networking has begun to spread in the past few years, gaining increasing popularity. With the rapid development of new and innovative applications for mobile devices like smartphones, approaches in battery technology have not retained momentum with promptly arising energy utilization demands. Thus energy utilization has becomes one of the major and fundamental issue for smartphone devices. In order meet the demanding s of saving energy, it is analytical to study and survey the energy utilization of applications on smartphones. In this study we will try to survey the energy efficient networking to find out and study existing smartphone attributes for the next generation network infrastructures.*

**Index Terms**— *Attributes, Energy Utilization, Next Generation, Smartphones, Applications.*

## I. INTRODUCTION

Communication networks which play an important role in our day to day life are intrinsically green. If we suppose cannot use a telecommunication system, the only way to deliver or to communicate a message from a source to a destination is to physically bring the source to the destination and destination to the source, but the fact this that the terminology is not highly energy efficient[1]. In fact, we should take into consideration the environmental benefits from the utilization of communications networks which decrease the road transportation for supplying information between various attributes for the next generation network infrastructures and authorize green systems. According to the latest perceptions, the term ‘Green Communications’ has been retailed and trademarked as a particular solution to label the increasing price and environmental effect of next generation telecommunications. Although, there is a scarcity or shortage of direct energy efficiency meanings and measures for wireless telecommunications to provide an impressive landmark for computing the overall improvement and evaluated Green Communications [2]. From the customers or users point of view, energy-efficient wireless communication is also one of the fundamental n critical issues. According to the 2010 wireless smartphone customer satisfaction study from J. D. Power and Associates [3], the

smartphone’s one of the most crucial brand iPhone received top marks in every category except for battery life. The latest report [3] from the survey in China also follows the same problem. In respect on the data in [3], up to 60% of the users complained that battery tolerance was the critical problem when utilizing 3G resources. Without advancement in battery technology, the battery life of the particular extreme sets will be the serious limitation for energy-greedy smartphone applications (e.g., video games, mobile P2P, respective video, cascading multimedia, smartphone TV, 3D services, and video sharing). The recognition of various smartphone attributes gives the first impression for customers; particularly when they are have the restricted time and bandwidth to do a successful research on a new product [4]. This observation of smartphone attributes also has strong relation with customer perception of whether the product will satisfy their requirements. To assemble the product attributions based on consumer perceptions will help professionals to understand consumers’ acceptance of products. In contrast to smartphones various attributes identified are: SMS-options; memory capacity, size of phone; price; brand; interface; luxuriousness; simplicity; attractiveness; colourfulness; texture; delicacy; harmoniousness; salience; rigidity; weight; button shape; camera; voice-activated dealing, Internet browsing; wireless connectivity and price [5]. The global objective of the study is to contribute to the body of knowledge in the whole area of technology adoption and telecommunication by surveying the attributes of smartphone that attract consumers to purchase mobile phones and use them on their own satisfaction.

The objectives on which the study mainly focuses are:

- To determine and study the attributes of smartphones that is influential in the selection and purchase of mobile phone.
- To examine the smartphone energy consumption behaviour for consumers in order to determine the views of respondents to embark on sustainable consumption.

## II. RELATED WORK

Many studies [6, 7, and 8] have observed that the energy consumption has become an important problem in energy management of mobile phones and have their own ways to save energy. However, we should first know the energy consumption of the applications on mobile phones. Accordingly, observing the energy utilization of smart phones is very important for saving energy to extend the lifetime of battery.

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\* Correspondence Author (s)

**Gowher Mushtaq\***, Faculty of Computer Science & Engineering, Shri Ramswaroop Memorial University Lucknow India, Lucknow, India.

**Shashank Singh**, Faculty of Computer Science & Engineering, Shri Ramswaroop Memorial University Lucknow India, Lucknow, India.

**Neeraj Kumar Tiwari**, Faculty of Computer Science & Engineering, Shri Ramswaroop Memorial University Lucknow India, Lucknow, India.

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For instance, we present a framework for energy monitoring that includes both the hardware and software setup, along with current observations from energy profiling of a mobile phone and a PA monitoring application. However, they focus on understanding the energy consumption of physical activity monitoring applications and do not provide energy consumption monitoring in a developer's perspective. Zhang et al. [9] describe Power Booter an automated power model construction technique that uses built-in battery voltage sensors and knowledge of battery discharge behavior to monitor power consumption while explicitly controlling the power management and activity states of individual components. Even though they provide energy consumption monitoring for the developers and users, they do not provide the application-level energy consumption monitoring. However, we propose a methodology in which we are studying and analyzing the attributes of smartphones through this it provides not only energy consumption monitoring for the developers and users, but also the application-level energy consumption monitoring. Numerous factors affect the battery lifetime of a smart phone. Despite the fact that each application that runs on the phone contributes differently to its battery drain, there are six fundamental hardware attributes that consume most of the power:

- Backlight
- Bluetooth
- Processor
- Wi-Fi
- Cell Radio and
- NFC (Near Field Communication)

How the energy consumption characteristics of network activity do over various smartphone attributes like back light, NFC, Bluetooth, Cell Radio etc. Compare with each other? How can we reduce the energy consumed by common applications using each of these technologies? To investigate these questions, we first go through a comprehensive measurement study to quantify the energy consumed by data transfers across these smartphone attributes. We find that the utilization of energy is fundamentally related to the characteristics of the workload and not just the total transfer size.

### III. RESEARCH METHODOLOGY

The aim of the methodology is for mobile products or services to find out the energy efficient existing attributes to be designed to reduce energy consumption. The current methodology is a design approach where a product or service is designed to fulfill both human and ecological needs. It is distilled to a checklist of various energy consuming attributes which are all to be fulfilled, in order to achieve the aim of the methodology. From the study work we have to find out the various smartphones attributes in order to achieve the aim of the methodology are given in a table:

Smartphones Attributes	
1	Backlight
2	Bluetooth
3	Processor
4	Wi-Fi
5	Cell Radio
6	NFC (Near Field Communication)

**Table 1. Next Generation Smartphone Attributes**

Now our further strategy is to explain the working and a latest terminology in the following smartphone attributes to deliver a confidential platform for the mobile consumers in order to make smartphone more and more energy efficient.

#### 1. BACKLIGHT

The battery life of a smartphone can be increased by various ways; however the first concept of our study is back light of a smartphone which give rise to a fundamental concept, the Green Mode, which sustains to the methodology.

**Green Mode App:** The Green Mode is an application concept for a Smart Phone that promotes the idea of switching off active functions and applications when the user of the smartphone does not need them for further communications. Fundamental key features of the Green Mode application are: Green vs. Fat Mode: Identification by the user of their primary or latest used functions and applications. All the primary functions and applications are then marked as Green Mode. The full functionality of the Smart Phone is the Fat Mode. For example when we put our mobile data on in our smartphone all the applications remain on.

**Green Mode Status:** An icon on the main information bar to alert the user that they are in the Green Mode.

**Toggle:** The user can toggle between Green Mode and Fat Mode according to their needs and enable their full-featured handset.

**Auto-Green Mode:** The device can automatically enter Green Mode when being idle for a period of time and the users can simply enable the full featured or Fat Mode when necessary.

**Customization:** The Green Mode app does not stipulate or force the user which applications or functions are considered Fat, and which are considered Green. Each individual user has individual preferences on frequently used functions or applications, and hence a Green Mode is customizable to address changing needs by the user.

#### 2. BLUETOOTH

Bluetooth low energy (Bluetooth BLE, LE, retailed as Bluetooth Smart is a wireless personal area network technology designed and marketed by the Bluetooth Special Interest Group aimed at novel applications in the health protection, ability, warnings, safety, and residence amusement industries. Compared to authoritative Bluetooth, Bluetooth Smart is calculated to supply greatly reduced power consumption and cost while maintaining a similar transmission domain. Bluetooth Smart was initially presented under the name Wibree by Nokia in 2007. It was combined into the dominant Bluetooth standard in 2010 with the adoption of the Bluetooth Core Specification Version 4.0. Mobile operating systems counting Android, iOS, Blackberry and windows Phone, genuinely assist Bluetooth Smart. The Bluetooth SIG anticipates more than 90 percent of Bluetooth-enabled smartphones will support Bluetooth Smart by 2018.

##### 2.1. Bluetooth 4.0

In the last year BLUETOOTH V2.1 dated the minimum available across devices. Although, the requirement for swift transfer speeds led to the development of Bluetooth v3.0 which is in the modern era has been meshed into the various latest smartphones now.

Being a technology, the advancement in Bluetooth terminology has evolved rapidly - so now, some high-end smartphones also have Bluetooth v4.0, which adds a new protocol called 'Low energy'. This utilizes a small part of the power consumed by conventional Bluetooth devices and provides faster transfer speeds too. As opposed to a standard 50 foot range (clear line for sight), it provides a domain range of 200 feet.

Example: Devices such as Apple's iPhone4S and Motorola's Droid Razr are the latest phones to come with Bluetooth v4.0. Some Ultra books like the Asus Zen Book also have Bluetooth 4.0.

### 2.2. Bluetooth Standard Releases

There have been many releases of the Bluetooth standard as updates have been made to ensure it keeps pace with the current technology and the needs of the users which are given in table:

**Table 2. Bluetooth Standard releases and Time line History**

Bluetooth Standard version	Release date	Key features of version
1.0	July 1999	Draft version of the Bluetooth standard
1.0a	July 1999	First published version of the Bluetooth standard
1.0b	Dec 1999	Small updates to cure minor problems and issues
1.0b+CE	Nov 2000	Critical Errata added to issue 1.0b of the Bluetooth standard
1.1	Feb 2001	First useable release. It was used by the IEEE for their standard - 2002 IEEE 802.15.1.
1.2	Nov 2003	This release of the Bluetooth standard added new facilities including frequency hopping and eSCO for improved voice performance. Was released by the IEEE as IEEE 802.15.1 - 2005. This was the last version issued by IEEE.
2.0+EDR	Nov 2004	This version of the Bluetooth standard added the enhanced data rate (EDR) to increase the throughput to 3.0 Mbps raw data rate
2.1	July 2007	This version of the Bluetooth standard added secure simple pairing to improve security.
3.0 + HS	Apr 2009	Bluetooth 3 added IEEE 802.11 as a high speed channel to increase the data rate to 10+ Mbps.
4.0	Dec 2009	The Bluetooth standard was updated to include Bluetooth Low Energy.

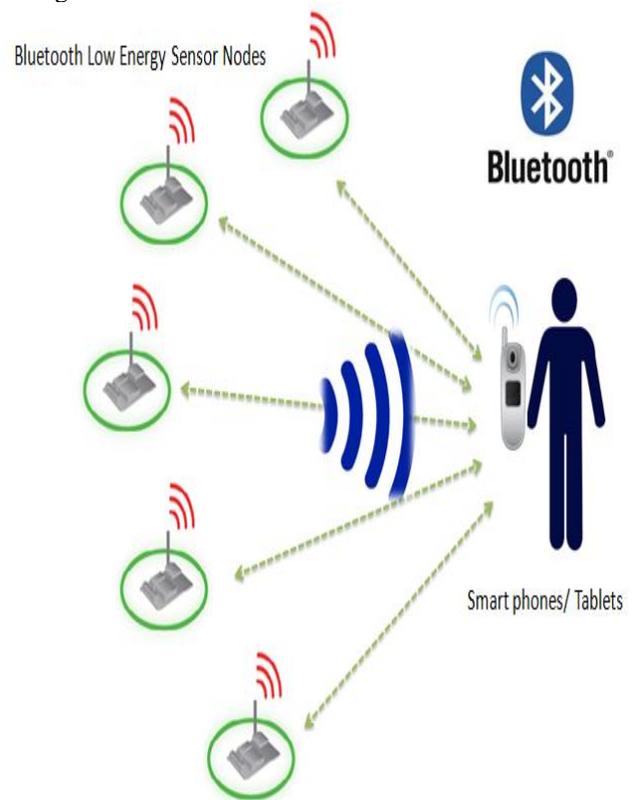
The Bluetooth 4.0 wireless protocol, also known as Bluetooth Low Energy (BLE) or Bluetooth Smart, provides inexpensive-energy power administration for scarce-range wireless connectivity that is location-sensible, and

context-sensible. Unsegregated with Wasp mote, Labellum's BLE application permits sensor devices to perform as real time location systems, with encoded data proceedings.

The main purpose of Wasp mote BLE application is to transmit data announcement, or I Beacons, that allocate sensor data to be broadcasted without the help of a hasty coupling process. BLE permits any device to connect to the Internet with a smartphone or tablet that links data to the Cloud between the Wi-Fi or 3G radio feasible in the mobile device.

The fundamental IoT-enabling platform, Wasp mote links any sensor, utilizing any wireless communication protocol, to any Cloud platform. In inclusion to Bluetooth Low Energy model, Wasp mote integrates with six radio protocols—including Wi-Fi, 802.15.4,Zigbee,3G, NFC, GPRS—and permits to switch linking any two of these strategies as required.

Figure below showing the sensing of Bluetooth through it sensing nodes.



**Figure 1. Bluetooth low energy sensor nodes.**

From the study we found that Bluetooth Low Energy and Bluetooth Smart connectivity as an efficient, energy-saving alternative for day to day objects and latest IoT applications in classifications such as healthcare, home automation, retail mobile tracking, and security.

Technical Characteristics – Bluetooth Low Energy Model

**Table 3. Key features of BLE.**

Key features	Why it matters
Protocol: Bluetooth 4.0 /Bluetooth Smart RX Sensitivity: -103dBm TX Power: [-23dBm, + 3dBm] Consumption: Sleep mode (0.4uA) / RX (8mA) / TX (36mA) AES 128 encryption used in master/slave Mode	BLE features ultra-low power utilization that permits devices to remain in service for years.  BLE permits both encoded coupled transmissions and quick broadcast data transmissions between sensor nodes and smartphones.
Accurate RSSI interpretation and timing response.	With the ability to calculate distances between fixed points and mobile objects, BLE module is ideal for real time indoor localization applications and mobile tracking where GPS cannot be utilized.
CE / FCC / IC certification; Japan and Korea qualified	Wasp mote BLE module is certified and ready for deployment in any country in the world.

### 3. Next Generation Smartphone Processor

A smartphone implementation processor is a system on a chip (SoC) outlined to assist applications running in a smartphone operating system environment such as Apple iOS, Android, Symbian or Windows CE/Mobile. A smartphone application processor anticipates independent operating environment that distributes all system potential required to assist a device's applications, counting graphics processing, memory management and multimedia decoding. For example, the Qualcomm Snapdragon smartphone application processor is allocated in many smart phones that use Snapdragon to run the Android operating system and Android applications. So in this part of communications, every smartphone manufacturer need not originate its own mobile application processor (although they can); this resemble reduces bill-of-materials (BoM) cost and makes it possible to develop low-cost "smart" consumer electronics.

#### 3.1. Comparison between Next Generation Smartphone Processors:

Table given below showing the comparison between two smartphone processors:

**Table 4. A comparison between future or Next Generation Smartphone processors.**

	Snapdragon 800 (MSM8974AB)	Snapdragon 805 (MSM8984)
CPU	2.3 GHz Krait 400 CPU	2.5 GHz Krait 450 CPU
Architecture	ARMv7	ARMv7-a
GPU	550 MHz Adreno 330	500 MHz Adreno 420
Memory	32-bit dual-channel	32-bit quad-channel

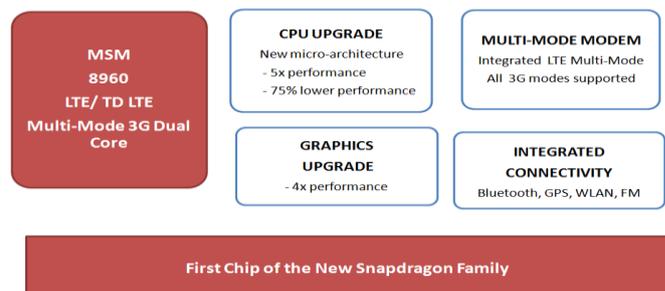
	LPDDR3	LPDDR3
Bandwidth	933 MHz (14.9 GB/s)	800 MHz (25.6 GB/s)
Modem	Gobi MDM9X25	Gobi MDM9x25/MDM9x35
Max. Data Bluetooth	150 Mbps Bluetooth 4.0	300Mbps Bluetooth 4.0
Wi-Fi	802.11n/a(2.4 and 5 GHz)	802.11n/ac(2.4 and 5GHz)
Process	TSMC 28nm HPm	TSMC 28nm HPm

### 3.2. Hummingbird vs. Snapdragon: The 1 GHz Smartphone face-off.

If we chase smartphone technology to every extent, we're sure to have heard of the Qualcomm Snapdragon processor. Qualcomm Snapdragon the existing smartphone CPU heavyweight; a 1 GHz processor stuffed with a large number of attributes, deployed upon the same ARM CPU technology that next generation smartphones such as the Droid, Palm Pre, Nokia N900 and iPhone 3GS utilize. Although, apart from different processors, the Snapdragon runs at 1 GHz and the others run at 600 MHz and under, and thus it turn out to be the chip of choice for superior smartphones.

The Snapdragon SoC (System on a Chip) has come into view on the market in various devices a short time ago. The most fundamental example is perhaps the Google Nexus One, although it had already came into existence in a hasty device, the HTC HD2. The HD2, had a Snapdragon processor as well as a massive 4.3-inch display (diagonally measured), and sustained excellent analysis that virtually without opposition ended with one crucial exception. World's first Multi-Mode 3G/4G integrated chipset for the future generation showing performance:

#### World's First Multi-Mode 3G/4G Integrated Chip Set



**Figure 2. Multi-Mode 3G/4G integrated Chipset.**

### 4. Next Generation Wi-Fi in Smartphones

Similar to numerous different technology advances, Wi-Fi is effectively on its process to fetching as orthodox as the electrical exit. And just a similar way the exit becomes different throughout the years to grow riskless and extra energy efficient, Wi-Fi is turnout a region into a next-generation adaptation that's secure Extra well founded and superior prepared to tackle not only current era's requirements but also the sign of future requirements that will come from various users, more devices and more data.

The several numbers of Wi-Fi-enabled devices has previously originated augmented in the last few decades or so, as the number of locations where Wi-Fi is approachable. A latest survey on Wi-Fi develop that free Wi-Fi was the most demanding utility between hotel visitors, thrashing out free parking and free breakfast. Now days, the number of latest devices connecting to Wi-Fi is propagated far off the traditional PC. , tablet computers, Smartphones, game consoles and the TV are among the latest to tackle into the network. Further are home amenities like washing machines, thermostats and refrigerators. The development is so fast that researchers anticipate that there will be 5 billion Wi-Fi connected devices worldwide by 2014.

#### 4.1. Next Generation Wi-Fi 802.11 ac

A new wireless Standard: In order to assemble these developing requirements from the eternally propagated expansion of Wi-Fi devices, there is a latest wireless standard being developed. The new standard, known as 802.11 ac, commits exceptional developments in authenticity, speed and superiority. The arrangement of inter media manipulate demonstrations and growing large number of devices orders extraordinary interpretation. The most high-powered 802.11 n devices round off at an extreme link rate of 450 megabits per second at compact domain, with decreasing representation as the range swells. In contradiction, the modern 802.11 ac standard can attain more than three times the performance of the present standard, with speeds up to 1.35 Gigabits per second. What's additional, 802.11 ac has the ability to sustain a top-level of performance at any domain, in contrast with its predecessors. The 3X speed advancement attained by the latest standard process that the 450 Mbps performance from today's fastest 3 antenna 802.11 n device can be attained by single antenna 802.11 ac device with homogeneous power consumption. This follows that a normal tablet with single antenna 802.11 n 150 Mbps Wi-Fi can now support 450 Mbps with 802.11 ac without any energy consumption or reduction in battery life.

#### 4.2. Wireless performance comparison

Next generation wireless protocol comparison between 802.11n and 802.11ac is given in a table:

Table 5. 802.11n and 802.11ac comparison

Antenna Configuration	802.11 n	802.11 ac
Single Stream (1x1)	150 Mbps	450 Mbps
Dual Stream (2x2)	300 Mbps	900 Mbps
Three Stream (3x3)	Three stream (3x3)	1.3 Gbps

Key advantages of 802.11 ac over 802.11n:

- Gigabit speed wireless with approximately 3 times the performance of 802.11 n.
- Better performance at any range with dead spots.
- Extra authentic links for media cascading with beam-forming.
- Extra Wi-Fi transmission capacity on your smartphone.

- Only employs the 5 GHz Band, which is less flat to interference.
- Inverted appropriate to 802.11 a & n, which also utilizes the 5 GHz band.

#### 5. Cell Radio

Cell radio is the radio the smartphone uses for data and phone calls; it has to be on during communications. If you turn it off you will not be able to receive or send phone calls or 3g data. If you do not anticipate utilizing it for phone calls or 3g data, you can turn it off. And use any other device like WiMAX or Wi-Fi for just data. But 3g data, text messages and phone calls will not work.

#### 5.1. Cell Radio Energy Consumption of Handset while in use

To date, little effort has been focused on the actual energy consumption by the users and data has been unclear and inconsistent. This is an area that clearly needs further study and definitive data. Nevertheless, indications that consumer usage of 3G services impact energy consumption are starting to become apparent, as seen in Table 6.

Table 6. Energy comparison between two smartphones.

Phone Model	Talk-Time Batter life	Battery Type
Nokia Lumia 1320 (3G on)	21 hours	3400 mAh
Nokia Lumia 1320 (3G off)	672 hours standby	3400 mAh
IPhone 5S (3G on)	10 hours	1440 mAh
IPhone 5S (3G off)	250 and by	1440

#### 6. NFC (Near Field Communication)

Near Field Communication Mutually developed by Philips and Sony, Near Field Communication (NFC) is a wireless connectivity technology that authorizes appropriate Band-Aid communication connecting electronic devices. NFC provides the absolute in satisfaction for linking all kinds of consumer devices and permits high-speed and uncomplicated communications. It is the absolute result for managing data in our glowingly multiplex and bridged world. NFC is intermediate to Philips' creativity of a world where each and every one can always linked to entertainment, services and information – anywhere and anytime. Its instinctive performance makes it especially uncomplicated for customers to use, while its integrated certainty makes it supreme for remission and commercial applications.

## 6.1. Advantages of NFC

Behaving as a reliable doorway to the connected world, futures NFC-authorized smartphone devices will permit consumers to access and store all types of confidential information on the move or at home. Normally by fetching two NFC-authorized devices close simultaneously, they automatically start network communications without requiring the user to configure the setup. NFC-amplify consumer devices can simply interchange and store your confidential information– pictures, messages, MP3 files, etc. Broadcasting feasible, zero configuration, instant natural connectivity and smart key access, NFC handles all the requirements of present days connected consumer as well as generating slots for modern smartphone services.

**Natural connectivity:** NFC delivers various natural approaches for connecting consumer devices, expanding the range of networking supplications. Just as you would walk across a room full of people to have a personal discussion with someone, relatively than screaming across it so that everyone could hear, NFC uses this fundamental principle to connect two devices. By providing growing amenities for the user when meshing with numerous consumer devices, NFC helps to bring Philips’ imagination of a connected world one more steps closer.

**Zero configurations:** Through NFC, two devices that are close together can automatically start a ‘communication’, permitting them to discover how they can collaborate. NFC provides uncomplicated link of consumer devices, such as smartphones, digital cameras, AV (Audio Visual) equipment,

PDAs, digital cameras, set-top boxes and computers. With NFC there is no longer any requirement for users to steer occasionally complicated setup strategies when transferring data in between consumer devices.

**Smart key access:** NFC is perfectly well suited with both Philips’ MIFARE® and Sony’s Felica contact less smart card platforms. These manifest systems deliver a solid justification for the introduction of NFC-authorized devices. This permits NFC devices, like your PDA or mobile phone, to function as an electronic key to acquire your home, car, office, or to pay for – as well as to function as – your transport ticket.

**Enabling mCommerce:** Mobile e-commerce or mCommerce is a broad area of stir, cowlng any proceedings involving transactions financial value managing through an electronic device such as a PDA or mobile phone. Presenting consumers the possibility to make any type of electronic payment wirelessly, NFC-enabled smartphone devices are effectively placed to become the core of mCommerce.

## 6.2. NFC and other Wireless Technologies

NFC is compatible with existing wireless standards. It can be utilized to begin Bluetooth, WLAN and Bluetooth and various other wireless connections without going through design cards. These connections are entrenched simply by holding the two NFC commodities close together, or by designing a device with contact less smart media.

**Table 7. NFC in comparison to other wireless technologies**

	NFC	IrDA	ZigBee	Bluetooth
Range	0.1 m	Upto 1 m	>10 m	Up to 1 m
Network Configuration	Peer to peer	Peer to peer	Point to multipoint	Point to multipoint
Set up time	< 0.1 s	~ 0.5 s	>1 s	~ 6 s
Speed	Up to 424 Kbit/s	115 Kbit/s	Up to 250 Kbit/s	Up to 721 Kbit/s
communication	Active to Active, active to passive	Active to active	Active to active	Active to active
Security	Yes (hardware)	No (except IFRM)	No	Yes (Protocol level)

## 6.3. NFC Products

NFC has currently two products available:

- The highly integrated PN511 transmission module and
- The PN531 smart transmission module.

## 6.4. Comparison table between BLE and NFC

	NFC	IrDA	ZigBee	Bluetooth
Range	0.1 m	Upto 1 m	>10 m	Up to 1 m

**Table 8. Comparison NFC, BLE and Bluetooth 2.1 + EDR**



Network Configuration	Peer to peer	Peer to peer	Point to multipoint	Point to multipoint
Set up time	< 0.1 s	~ 0.5 s	>1 s	~ 6 s
Speed	Up to 424 Kbit/s	115 Kbit/s	Up to 250 Kbit/s	Up to 721 Kbit/s
Communication	Active to Active, active to passive	Active to active	Active to active	Active to active
Security	Yes (hardware)	No (except IFRM)	No	Yes (Protocol level)

#### IV. CONCLUSION

This paper presents the study of the existing attributes of smartphones for the next generation network infrastructures, which can be used to monitor and analyze the energy consumption of applications on smartphones. The software system presented runs on Android operating system and iOS it is able to accurately record the energy consumption of applications and rank applications according to their energy consumption rates. We have explained the statically comparison overview of the smart phone in terms of its functionality through its attributes on monitoring and analyzing the energy consumption of the applications on smartphones. Although tremendous efforts done by hardware manufacturers and operating system vendors but Mobile handsets are still power-hungry devices because they incorporate power-hungry hardware resources such as touchscreen displays and location sensors, and they support Internet data services so they are always connected to the network. Now researchers have been emphasizing the need of considering energy as a fundamental system resource in mobile devices.

In short words, we present a comprehensive survey of the power utilization of the latest smartphones and covered studies that measured power in the energy consuming attributes of a Smart phone. Further we can compare the NFC wireless technology with FFC (far-field communication) on the basis of Future Generation Network Infrastructures.

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**Gowher Mushtaq** Gowher Mushtaq completed my Graduation from Govt. Boys Degree College Anantnag, M.Sc. Information Technology from Ultra Khand Technical University Dehradun, Presently he is Pursuing M.Tech in Computer Science and Engineering from Shri Ramswaroop Memorial University Lucknow India. My research interest is in Green Communications.



**Shashank Singh** I have completed my B.tech Computer Science and Engineering from ICFAI University Dehradun, now Pursuing M.tech Computer Science & Engineering, From Shri Ramswaroop Memorial University Lucknow India, My area of Research is computer Networks, trying to get more and more achievements in this field.



**Neeraj Kumar Tiwari** Dr. Neeraj Kumar Tiwari (M. Tech, PhD, EACCME-Italy), an Asstt. Professor in the department of CSE, Shri Ramswaroop Memorial University, UP, India. His area of interest includes Green Communication and E-Health. He has authored a large number of research papers and recipient of numerous honours and awards of National and International repute.

