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Yearly News letter

(Only for Internal Circulation)

HOD's Message 

- Education, particularly Technical Education is playing a vital role in the development of the country by creating skilled manpower, enhancing industrial productivity and improving the quality of life. People talks about wonders of the world and include structures and monuments but Communication Engineering is the greatest wonders of the world that even no one imagined. To continuously spread the quality technical education we the Dept of Electronics and Communication Engineering are committed to take up responsibility of the holistic growth of the pupil coming in to its folds, is committed to make all possible efforts to help in realizing their dreams as well as the society to which he or she hails from.

Prof. Rupesh Dubey

HOD EC Dept.

Mobile Operating Systems

Android

Android is an open-source platform founded in October 2003 by Andy Rubin and backed by Google, along with major hardware and software developers (such as Intel, HTC, ARM, Motorola and Samsung) that form the Open Handset Alliance. In October 2008, HTC released the HTC Dream, the first phone to use Android. The software suite included on the phone consists of integration with Google's proprietary applications, such as Maps, Calendar, and Gmail, and a full HTML web browser. Android supports the execution of native applications and third-party apps which are available via Google Play, which launched in October 2008 as Android Market. By Q4 2010, Android became the best-selling smart phone platform.

Bada

The Bada operating system for smart phones was announced by Samsung in November 2009. The first Bada-based phone was the Samsung Wave S8500, released in June 2010. Samsung shipped 4.5 million phones running Bada in Q2 of 2011. In 2013, Bada merged with a similar platform called Tizen.

BlackBerry

In 1999, RIM released its first BlackBerry devices, providing secure real-time push-email communications on wireless devices. Services such as BlackBerry Messenger provide the integration of all communications into a single inbox. There are 80 million active BlackBerry service subscribers and the 200 millionth BlackBerry smart phones were shipped in September 2012. Most recently, RIM has undergone a platform transition, changing its name to BlackBerry and making new devices on a new platform named "BlackBerry 10."

Firefox OS

Firefox OS (originally called the boot to gecko project) was demonstrated by Mozilla in February 2012. It was designed to have a complete community based alternative system for mobile devices, using open standards and HTML5 applications. The first commercially available

Firefox OS phones were ZTE Open and Alcatel One Touch Fire. As of 2014 more companies have partnered with Mozilla including Panasonic (which is making a smart TV with Firefox OS) and Sony.

IOS

In 2007, Apple Inc. introduced the iPhone, one of the first mobile phones to use a multi-touch interface. The iPhone was notable for its use of a large touch screen for direct finger input as its main means of interaction, instead of a stylus, keyboard, and/or keypad as typical for smart phones at the time. In July 2008, Apple introduced its second generation iPhone with a much lower list price and 3G support. Simultaneously, they introduced the App Store, which allowed any iPhone to install third-party native applications. Featuring over 500 applications at launch, the App Store eventually achieved 1 billion downloads in the first year, and 15 billion by 2011.

Palm OS

In late 2001, Handspring launched their own Springboard GSM phone module with limIn early 2002; Handspring released the Palm OS Treo smart phone with both a touch screen and a full keyboard. The Treo had wireless web browsing, email, calendar, a contact organizer and mobile third-party applications that could be downloaded or synced with a computer. Handspring was soon acquired by Palm, which released the Treo 600 and continued, though the series eventually took on Windows Mobile. After buying Palm, Inc, in 2011 Hewlett-Packard (HP) finally discontinued its smart phones and tablets production using web OS which is initial developed by Palm, Inc.

Sailfish OS

The Sailfish OS is based on the Linux kernel and Mer. Additionally Sailfish OS includes a partially or completely proprietary multi-tasking user interface programmed by Jolla. This user interface differentiates Jolla smart phones from others. Sailfish OS is intended to be a system made by many of the MeeGo team, which left Nokia to form Jolla, utilizing funding from Nokia's "Bridge" program which helps establish and support start-up companies formed by ex-Nokia employees.

Symbian

Symbian was originally developed by Psion as EPOC32. It was the world's most widely used smart phone operating system until Q4 2010, though the platform never gained popularity or widespread awareness in the U.S., as it did in Europe and Asia. The first Symbian phone, the touch screen Ericsson R380 Smartphone, was released in 2000, and was the first device marketed as a "smart phone". It combined a PDA with a mobile phone. In February 2011, Nokia announced that it would replace Symbian with Windows Phone as the operating system on all of its future smart phones, with the platform getting abandoned throughout the following few years.

Windows Mobile

Windows Mobile was based on the Windows CE kernel and first appeared as the Pocket PC 2000 operating system. Throughout its lifespan, the operating system was available in both touch screen and non-touch screen formats. It was supplied with a suite of applications developed with the Microsoft Windows API and was designed to have features and appearance somewhat similar to desktop versions of Windows. Third parties could develop software for Windows Mobile with no restrictions imposed by Microsoft. Software applications were eventually purchasable from Windows Marketplace for Mobile during the service's brief lifespan.

Windows Phone

In February 2010, Microsoft unveiled Windows Phone 7 with a User Interface inspired by Microsoft's "Metro Design Language", to replace Windows Mobile. Windows Phone 7 integrates with Microsoft services such as Microsoft Sky Drive, Office, Xbox and Bing, as well as non-Microsoft services such as Face book, Twitter and Google accounts. This software platform runs on most Nokia smart phones, it has received some positive reception from the technology press and been praised for its uniqueness and differentiation.

Ref. Mobile Operating SystemWikipedia

Academic Achievements of EC Department in the year 2013-14.

Advisory Board meeting

The advisory board meeting of ECE, Department IES IPS Academy held twice in a year headed by eminent industrialist from leading top notch industries, academicians from national and international of repute institute. In advisory board meeting long term and short term plans of EC Department are discussed and suggested major plans are incorporated for the benefit of students, faculties and institute.

The details of advisory board meeting are:-

1. The first advisory board meeting for the year 2013-14 organized on date 25/9/2013, The chief guest was Dr.T.S.Rathore eminent academician from SFIT, Mumbai and Mr. H.S.Vora Head of Laser Section CAT, Indore, Principal of the Institute, Head of the Department and all faculties of ECE Department were also present. In the meeting PEO, CO & PO of the department are discussed, and make a roadmap to attain the PO's.

2. The second advisory board meeting for the year 2013-14 organized on date 6/3/2014.The invited guests were Dr. T.S.Lamba eminent academicians, Mr.Saha & Mr. Gaurav Dhawan from Semiconductor industry. In the meeting the short term and long term plans are discussed. In the meeting Principal of the Institute, Head of the Department and all faculties of ECE Department were also present.

Workshop:

For the technical skill development of the students as well as faculties department organized the workshop time to time.

The details of the workshop are:-

1. Two week faculty development ISTE workshop organized on "Signal and System" from 2/1/2014 to 12/1/2014 conducted by IIT Kharagpur.

2. Two days Robotics Workshop for students is organized on 24/10/2014 to 25/10/2014 conducted by EC Department.

Expert Lecture/Seminar:

The department organizes the expert lecture/seminar series round the year for the knowledge and technical skill upliftment of BE and ME students on latest trends. So that not only they can learn beyond the syllabus but also they aware of latest technology.

The expert lectures/seminars are delivered by eminent academicians from national level institute, industry experts.

The following expert lecture series organized in the year 2013-14.

1. Expert lecture of Mr. P.S.Rathore Akashwani Indore on speech processing organized on 13-09-2013.

2. Expert lecture of Dr.Abhay Kumar Head, SoEx, Indore on Literature Survey of Research Paper on 18/09/2013.

3. Expert lecture of Mr. Y.Tyagi & Mr. Surendra Yadav,RRCAT Indore on Matlab Application in Science & Engineering on 24/09/2013.

4. Expert lecture of Dr.T.S.Rathore Dean SFIT, Mumbai on Analysis of circuit with controlled source using superposition theorem.

5. Expert lecture of Mr.H.S.Vora RRCAT, Indore on Image based measurement for R&D Applications on 25/9/2013.

6. Expert lecture of Dr. R.B.Pachori IIT Indore on Signal Processing.

7. Expert lecture of Dr. Rajesh Bodade MCTE, Mhow on Digital Signal Processing on 26/11/2013.

8. Expert lecture of Dr. Varun Bajaj IIITM Gwalior on Analysis 7 Classification of epileptic seizure on 13/2/2014.

Student Achievements:

The students of EC department are enthusiastic, energetic and active. They participated in sports, cultural events organized by IES and also by other institutes.

The students who secured positions in various activities organized under annual festival swaranjal 2014 are

Group Dance Competition "Swaranjali 2014"

1. Sanke t Rajput(got 2 position EC) I Vyr.
2. Samyak Jain got 2 positions (EC) IV yr.

Mahendi Competition "Swaranjali 2014"

1. Anupriya Jain got 2 position (EC) I yr.

Rangoli Competition "Swaranjali 2014"

1. Deepa Bansal got 1 position (II yr)
2. Gunjan Rathore got 1 position (II yr)
3. Kanchan Naidu got 2 positions (III yr)
4. Poorvi Jain got 2 positions (III yr)

Ananad Mela Competition "Swaranjali 2014"

1. Anshul Gupta got 2 positions (III yr)
2. Aakash Gupta got 2 positions (III yr)

Technical Jewelry Competition "Swaranjali 2014"

1. Deepa Bansal got 1 position(III yr)

Skit Competition "Swaranjali 2014"

2. Saurav Suman got 1 position(III yr)
3. Abhishek Gupta got 1 position(III yr)

4. Yash Agarwal got 1 position(III yr)
5. Nirmal Mehta got 1 position(III yr)
6. Shiv Narayan got 1 position(III yr)
7. Vishal Tyagi got 1 position(III yr)
8. Palash Jain got 1 position(III yr)

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Editorial Board Student Members:-

Mr. Ashish Kothari II year 2014

Mr. Arvind Raghuwanshi II year 2014

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Prof. Rupesh Dubey

HOD EC Dept.

4 Generation Mobile Technology

4G

This article is about the mobile telecommunications standard. For other uses, see 4G (disambiguation).

4G, short for **fourth generation**, is the fourth generation of mobile telecommunications technology, succeeding 3G and preceding 5G. A true 4G system must provide capabilities defined by ITU in IMT Advanced. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

Two 4G candidate systems are commercially deployed: the Mobile WiMAX standard (first used in South Korea in 2007), and the first-release Long Term Evolution (LTE) standard (in Oslo, Norway and Stockholm, Sweden since 2009). It has however been debated if these first-release versions should be considered to be 4G or not, as discussed in the technical definition section below.

In the United States, Sprint (previously Clearwire) has deployed Mobile WiMAX networks since 2008, while MetroPCS became the first operator to offer LTE service in 2010. USB wireless modems were among the first devices able to access these networks, with WiMAX smartphones becoming available during 2010, and LTE smartphones arriving in 2011. 3G and 4G equipment made for other continents are not always compatible because of different frequency bands. Mobile WiMAX is not available for the European market as of April 2012.

Technical understanding

In March 2008, the International Telecommunications Union-Radio communications sector (ITU-R) specified a set of requirements for 4G standards, named the International Mobile

Telecommunications Advanced (IMT-Advanced) specification, setting peak speed requirements for 4G service at 100 megabits per second (Mbit/s) for high mobility communication (such as from trains and cars) and 1 gigabit per second (Gbit/s) for low mobility communication (such as pedestrians and stationary users).[1]

Since the first-release versions of Mobile WiMAX and LTE support much less than 1 Gbit/s peak bit rate, they are not fully IMT-Advanced compliant, but are often branded 4G by service providers. According to operators, a generation of network refers to the deployment of a new non-backward-compatible technology. On December 6, 2010, ITU-R recognized that these two technologies, as well as other beyond-3G technologies that do not fulfill the IMT-Advanced requirements, could nevertheless be considered "4G", provided they represent forerunners to IMT-Advanced compliant versions and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed".[2]

Mobile WiMAX Release 2 (also known as *WirelessMAN-Advanced* or *IEEE 802.16m'*) and LTE Advanced (LTE-A) are IMT-Advanced compliant backwards compatible versions of the above two systems, standardized during the spring 2011,[*citation needed*] and promising speeds in the order of 1 Gbit/s. Services were expected in 2013.[*needs update*]

As opposed to earlier generations, a 4G system does not support traditional circuit-switched telephony service, but all-Internet Protocol (IP) based communication such as IP telephony. As seen below, the spread spectrum radio technology used in 3G systems, is abandoned in all 4G candidate systems and replaced by OFDMA multi-carrier transmission and other frequency-domain equalization (FDE) schemes, making it possible to transfer very high bit rates despite extensive multi-path radio propagation (echoes). The peak bit rate is further improved by smart antenna arrays for multiple-input multiple-output (MIMO) communications.

Background

The nomenclature of the generations generally refers to a change in the fundamental nature of the service, non-backwards-compatible transmission technology, higher peak bit rates, new

frequency bands, wider channel frequency bandwidth in Hertz, and higher capacity for many simultaneous data transfers (higher system spectral efficiency in bit/second/Hertz/site).

New mobile generations have appeared about every ten years since the first move from 1981 analogue (1G) to digital (2G) transmission in 1992. This was followed, in 2001, by 3G multi-media support, spread spectrum transmission and at least 200 kbit/s peak bit rate, in 2011/2012 to be followed by "real" 4G, which refers to all-Internet Protocol (IP) packet-switched networks giving mobile ultra-broadband (gigabit speed) access.

While the ITU has adopted recommendations for technologies that would be used for future global communications, they do not actually perform the standardization or development work themselves, instead relying on the work of other standard bodies such as IEEE, The WiMAX Forum and 3GPP.

In the mid-1990s, the ITU-R standardization organization released the IMT-2000 requirements as a framework for what standards should be considered 3G systems, requiring 200 kbit/s peak bit rate. In 2008, ITU-R specified the IMT-Advanced (International Mobile Telecommunications Advanced) requirements for 4G systems.

The fastest 3G-based standard in the UMTS family is the HSPA+ standard, which is commercially available since 2009 and offers 28 Mbit/s downstream (22 Mbit/s upstream) without MIMO, i.e. only with one antenna, and in 2011 accelerated up to 42 Mbit/s peak bit rate downstream using either DC-HSPA+ (simultaneous use of two 5 MHz UMTS carriers)[3] or 2x2 MIMO. In theory speeds up to 672 Mbit/s are possible, but have not been deployed yet. The fastest 3G-based standard in the CDMA2000 family is the EV-DO Rev. B, which is available since 2010 and offers 15.67 Mbit/s downstream.[*citation needed*]

IMT-Advanced requirements

This article refers to 4G using IMT-Advanced (*International Mobile Telecommunications Advanced*), as defined by ITU-R. An IMT-Advanced cellular system must fulfill the following requirements:

- Be based on an all-IP packet switched network.
- Have peak data rates of up to approximately 100 Mbit/s for high mobility such as mobile access and up to approximately 1 Gbit/s for low mobility such as nomadic/local wireless access.[1]
- Be able to dynamically share and use the network resources to support more simultaneous users per cell.
- Use scale-able channel bandwidths of 5–20 MHz, optionally up to 40 MHz.[1][5]
- Have peak link spectral efficiency of 15-bit/s/Hz in the downlink, and 6.75-bit/s/Hz in the uplink (meaning that 1 Gbit/s in the downlink should be possible over less than 67 MHz bandwidth).
- System spectral efficiency is, in indoor cases, 3-bit/s/Hz/cell for downlink and 2.25-bit/s/Hz/cell for uplink.[1]
- Smooth handovers across heterogeneous networks.
- The ability to offer high quality of service for next generation multimedia support.

In September 2009, the technology proposals were submitted to the International Telecommunication Union (ITU) as 4G candidates.[6] Basically all proposals are based on two technologies:

- LTE Advanced standardized by the 3GPP
- 802.16m standardized by the IEEE (i.e. WiMAX)

Implementations of Mobile WiMAX and first-release LTE are largely considered a stopgap solution that will offer a considerable boost until WiMAX 2 (based on the 802.16m spec) and LTE Advanced are deployed. The latter's standard versions were ratified in spring 2011, but are still far from being implemented.[4]

The first set of 3GPP requirements on LTE Advanced was approved in June 2008.[7] LTE Advanced was to be standardized in 2010 as part of Release 10 of the 3GPP specification. LTE Advanced will be based on the existing LTE specification Release 10 and will not be defined as

a new specification series. A summary of the technologies that have been studied as the basis for LTE Advanced is included in a technical report.[8]

Some sources consider first-release LTE and Mobile WiMAX implementations as pre-4G or near-4G, as they do not fully comply with the planned requirements of 1 Gbit/s for stationary reception and 100 Mbit/s for mobile.[*citation needed*]

Confusion has been caused by some mobile carriers who have launched products advertised as 4G but which according to some sources are pre-4G versions, commonly referred to as '3.9G', which do not follow the ITU-R defined principles for 4G standards, but today can be called 4G according to ITU-R. A common argument for branding 3.9G systems as new-generation is that they use different frequency bands from 3G technologies that they are based on a new radio-interface paradigm and that the standards are not backwards compatible with 3G,[*citation needed*] whilst some of the standards are forwards compatible with IMT-2000 compliant versions of the same standards.[

System standards

IMT-2000 compliant 4G standards

As of October 2010, ITU-R Working Party 5D approved two industry-developed technologies (LTE Advanced and WirelessMAN-Advanced)[9] for inclusion in the ITU's International Mobile Telecommunications Advanced program (IMT-Advanced program), which is focused on global communication systems that will be available several years from now.

LTE Advanced

LTE Advanced (Long Term Evolution Advanced) is a candidate for IMT-Advanced standard, formally submitted by the 3GPP organization to ITU-T in the fall 2009, and expected to be released in 2013. The target of 3GPP LTE Advanced is to reach and surpass the ITU requirements.[10] LTE Advanced is essentially an enhancement to LTE. It is not a new technology, but rather an improvement on the existing LTE network. This upgrade path makes it

more cost effective for vendors to offer LTE and then upgrade to LTE Advanced which is similar to the upgrade from WCDMA to HSPA. LTE and LTE Advanced will also make use of additional spectrums and multiplexing to allow it to achieve higher data speeds. Coordinated Multi-point Transmission will also allow more system capacity to help handle the enhanced data speeds. Release 10 of LTE is expected to achieve the IMT Advanced speeds. Release 8 currently supports up to 300 Mbit/s of download speeds which is still short of the IMT-Advanced standards.[11]

Data speeds of LTE Advanced

	LTE Advanced
Peak download	1 Gbit/s
Peak upload	500 Mbit/s

IEEE 802.16m or WirelessMAN-Advanced

The IEEE 802.16m or WirelessMAN-Advanced evolution of 802.16e is under development, with the objective to fulfill the IMT-Advanced criteria of 1 Gbit/s for stationary reception and 100 Mbit/s for mobile reception.[12]

Forerunner versions3GPP Long Term Evolution (LTE)

Telia-branded Samsung LTE modem

The pre-4G 3GPP Long Term Evolution (LTE) technology is often branded "4G-LTE", but the first LTE release does not fully comply with the IMT-Advanced requirements. LTE has a

theoretical net bit rate capacity of up to 100 Mbit/s in the downlink and 50 Mbit/s in the uplink if a 20 MHz channel is used — and more if multiple-input multiple-output (MIMO), i.e. antenna arrays, are used.

The physical radio interface was at an early stage named *High Speed OFDM Packet Access* (HSOPA), now named Evolved UMTS Terrestrial Radio Access (E-UTRA). The first LTE USB dongles do not support any other radio interface.

The world's first publicly available LTE service was opened in the two Scandinavian capitals, Stockholm (Ericsson and Nokia Siemens Networks systems) and Oslo (a Huawei system) on December 14, 2009, and branded 4G. The user terminals were manufactured by Samsung.[13] As of November 2012, the five publicly available LTE services in the United States are provided by MetroPCS,[14] Verizon Wireless,[15] AT&T Mobility, U.S. Cellular,[16] Sprint,[17] and T-Mobile US.[18]

T-Mobile Hungary launched a public beta test (called *friendly user test*) on 7 October 2011, and has offered commercial 4G LTE services since 1 January 2012.

In South Korea, SK Telecom and LG U+ have enabled access to LTE service since 1 July 2011 for data devices, slated to go nationwide by 2012.[19] KT Telecom closed its 2G service by March 2012, and complete the nationwide LTE service in the same frequency around 1.8 GHz by June 2012.In the United Kingdom, LTE services were launched by EE in October 2012,[20] and by O2 and Vodafone in August 2013.[21]

Data speeds of LTE	
	LTE
Peak download	100 Mbit/s
Peak upload	50 Mbit/s

Mobile WiMAX (IEEE 802.16e)

The Mobile WiMAX (IEEE 802.16e-2005) mobile wireless broadband access (MWBA) standard (also known as WiBro in South Korea) is sometimes branded 4G, and offers peak data rates of 128 Mbit/s downlink and 56 Mbit/s uplink over 20 MHz wide channels.[*citation needed*]

In June 2006, the world's first commercial mobile WiMAX service was opened by KT in Seoul, South Korea.[22]

Sprint has begun using Mobile WiMAX, as of 29 September 2008, branding it as a "4G" network even though the current version does not fulfil the IMT Advanced requirements on 4G systems.[23]

In Russia, Belarus and Nicaragua WiMax broadband internet access is offered by a Russian company Scartel, and is also branded 4G, Yota.

Data speeds of WiMAX

	WiMAX
Peak download	128 Mbit/s
Peak upload	56 Mbit/s

TD-LTE for China market

Just as Long-Term Evolution (LTE) and WiMAX are being vigorously promoted in the global telecommunications industry, the former (LTE) is also the most powerful 4G mobile communications leading technology and has quickly occupied the Chinese market. TD-LTE, one of the two variants of the LTE air interface technologies, is not yet mature, but many domestic and international wireless carriers are, one after the other turning to TD-LTE.

IBM's data shows that 67% of the operators are considering LTE because this is the main source of their future market. The above news also confirms IBM's statement that while only 8% of the operators are considering the use of WiMAX, WiMAX can provide the fastest network transmission to its customers on the market and could challenge LTE.

TD-LTE is not the first 4G wireless mobile broadband network data standard, but it is China's 4G standard that was amended and published by China's largest telecom operator - China Mobile. After a series of field trials, is expected to be released into the commercial phase in the next two years. Ulf Ewaldsson, Ericsson's vice president said: "the Chinese Ministry of Industry and China Mobile in the fourth quarter of this year will hold a large-scale field test, by then, Ericsson will help the hand." But viewing from the current development trend, whether this standard advocated by China Mobile will be widely recognized by the international market is still debatable.

Discontinued candidate systems

UMB (formerly EV-DO Rev. C)

Main article: Ultra Mobile Broadband

UMB (Ultra Mobile Broadband) was the brand name for a discontinued 4G project within the 3GPP2 standardization group to improve the CDMA2000 mobile phone standard for next generation applications and requirements. In November 2008, Qualcomm, UMB's lead sponsor, announced it was ending development of the technology, favouring LTE instead.[24] The objective was to achieve data speeds over 275 Mbit/s downstream and over 75 Mbit/s upstream.

Flash-OFDM

At an early stage the Flash-OFDM system was expected to be further developed into a 4G standard.

iBurst and MBWA (IEEE 802.20) systems

The iBurst system (or HC-SDMA, High Capacity Spatial Division Multiple Access) was at an early stage considered to be a 4G predecessor. It was later further developed into the Mobile Broadband Wireless Access (MBWA) system, also known as IEEE 802.20.

Data rate comparison

The following table shows a comparison of the 4G candidate systems as well as other competing technologies.

Comparison of mobile Internet access methods

Common Name	**Family**	**Primary Use**	**Radio Tech**	**Downstream (Mbit/s)**	**Upstream (Mbit/s)**	**Notes**
HSPA+	3GPP	3G Data	CDMA/FDD MIMO	21 42 84 672	5.8 11.5 22 168	HSPA+ is widely deployed. Revision 11 of the 3GPP states that HSPA+ is expected to have a throughput capacity of 672 Mbit/s.
LTE	3GPP	General 4G	OFDMA/MIMO	100 Cat3 150 Cat4	50 Cat3/4	LTE-Advanced

Comparison of mobile Internet access methods

Common Name	**Family**	**Primary Use**	**Radio Tech**	**Downstream (Mbit/s)**	**Upstream (Mbit/s)**	**Notes**
			/SC-FDMA	300 Cat5 (in 20 MHz FDD) [25]	75 Cat5 (in 20 MHz FDD)[25]	update expected to offer peak rates up to 1 Gbit/s fixed speeds and 100 Mb/s to mobile users.
WiMax rel 1	802.16	WirelessMAN	MIMO-SOFDMA	37 (10 MHz TDD)	17 (10 MHz TDD)	With 2x2 MIMO.[26]
WiMax rel 1.5	802.16-2009	WirelessMAN	MIMO-SOFDMA	83 (20 MHz TDD) 141 (2x20 MHz FDD)	46 (20 MHz TDD) 138 (2x20 MHz FDD)	With 2x2 MIMO.Enhanced with 20 MHz channels in 802.16-2009[26]
WiMAX rel 2	802.16m	WirelessMAN	MIMO-SOFDMA	2x2 MIMO 110 (20 MHz	2x2 MIMO 70 (20 MHz	Also, low mobility users can aggregate multiple

Comparison of mobile Internet access methods

Common Name	**Family**	**Primary Use**	**Radio Tech**	**Downstream (Mbit/s)**	**Upstream (Mbit/s)**	**Notes**
				TDD) 183 (2x20 MHz FDD) 4x4 MIMO 219 (20 MHz TDD) 365 (2x20 MHz FDD)	TDD) 188 (2x20 MHz FDD) 4x4 MIMO 140 (20 MHz TDD) 376 (2x20 MHz FDD)	channels to get a download throughput of up to 1 Gbit/s[26]
Flash-OFDM	Flash-OFDM	Mobile Internet mobility up to 200 mph (350 km/h)	Flash-OFDM	5.3 10.6 15.9	1.8 3.6 5.4	Mobile range 30 km (18 miles) extended range 55 km (34 miles)
HIPERMAN	HIPERMAN	Mobile Internet	OFDM	56.9		

Comparison of mobile Internet access methods

Common Name	Family	Primary Use	Radio Tech	Downstream (Mbit/s)	Upstream (Mbit/s)	Notes
Wi-Fi	802.11 (11n)	Mobile Internet	OFDM/MIMO	288.8 (using 4x4 configuration in 20 MHz bandwidth) or 600 (using 4x4 configuration in 40 MHz bandwidth)		Antenna, RF front end enhancements and minor protocol timer tweaks have helped deploy long range P2P networks compromising on radial coverage, throughput and/or spectra efficiency (310 km & 382 km)
iBurst	802.20	Mobile Internet	HC-SDMA/TDD/MIMO	95	36	Cell Radius: 3–12 km Speed: 250 km/h Spectral Efficiency: 13 bits/s/Hz/cell

Comparison of mobile Internet access methods

Common Name	**Family**	**Primary Use**	**Radio Tech**	**Downstream (Mbit/s)**	**Upstream (Mbit/s)**	**Notes**
						Spectrum Reuse Factor: "1"
EDGE Evolution	GSM	Mobile Internet	TDMA/FDD	1.6	0.5	3GPP Release 7
UMTS W-CDMA HSPA (HSDPA+HSUPA)	UMTS/3GSM	General 3G	CDMA/FDD CDMA/FDD/MIMO	0.384 14.4	0.384 5.76	HSDPA is widely deployed. Typical downlink rates today 2 Mbit/s, ~200 kbit/s uplink; HSPA+ downlink up to 56 Mbit/s.
UMTS-TDD	UMTS/3GSM	Mobile Internet	CDMA/TDD	16		Reported speeds according to IPWireless using

Comparison of mobile Internet access methods

Common Name	**Family**	**Primary Use**	**Radio Tech**	**Downstream (Mbit/s)**	**Upstream (Mbit/s)**	**Notes**
						16QAM modulation similar to HSDPA+HSUPA
EV-DO Rel. 0 **EV-DO Rev.A** **EV-DO Rev.B**	CDMA2000	Mobile Internet	CDMA/FDD	2.45 3.1 4.9xN	0.15 1.8 1.8xN	Rev B note: N is the number of 1.25 MHz carriers used. EV-DO is not designed for voice, and requires a fallback to 1xRTT when a voice call is placed or received.

Notes: All speeds are theoretical maximums and will vary by a number of factors, including the use of external antennas, distance from the tower and the ground speed (e.g. communications on a train may be poorer than when standing still). Usually the bandwidth is shared between several terminals. The performance of each technology is determined by a number of constraints,

including the spectral efficiency of the technology, the cell sizes used, and the amount of spectrum available. For more information, see *Comparison of wireless data standards*.

For more comparison tables, see bit rate progress trends, comparison of mobile phone standards, spectral efficiency comparison table and OFDM system comparison table.

Principal technologies in all candidate systems

> This section **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.

Key features

The following key features can be observed in all suggested 4G technologies:

- Physical layer transmission techniques are as follows:[27]
  - MIMO: To attain ultra high spectral efficiency by means of spatial processing including multi-antenna and multi-user MIMO
  - Frequency-domain-equalization, for example *multi-carrier modulation* (OFDM) in the downlink or *single-carrier frequency-domain-equalization* (SC-FDE) in the uplink: To exploit the frequency selective channel property without complex equalization
  - Frequency-domain statistical multiplexing, for example (OFDMA) or (single-carrier FDMA) (SC-FDMA, a.k.a. linearly precoded OFDMA, LP-OFDMA) in the uplink: Variable bit rate by assigning different sub-channels to different users based on the channel conditions
  - Turbo principle error-correcting codes: To minimize the required SNR at the reception side
- Channel-dependent scheduling: To use the time-varying channel
- Link adaptation: Adaptive modulation and error-correcting codes
- Mobile IP utilized for mobility

- IP-based femtocells (home nodes connected to fixed Internet broadband infrastructure)

As opposed to earlier generations, 4G systems do not support circuit switched telephony. IEEE 802.20, UMB and OFDM standards lack soft-handover support, also known as cooperative relaying.

Multiplexing and access schemes

> This section **contains information of unclear or questionable importance or relevance to the article's subject matter**. Please help improve this article by clarifying or removing superfluous information. *(May 2010)*

Recently, new access schemes like Orthogonal FDMA (OFDMA), Single Carrier FDMA (SC-FDMA), Interleaved FDMA, and Multi-carrier CDMA (MC-CDMA) are gaining more importance for the next generation systems. These are based on efficient FFT algorithms and frequency domain equalization, resulting in a lower number of multiplications per second. They also make it possible to control the bandwidth and form the spectrum in a flexible way. However, they require advanced dynamic channel allocation and adaptive traffic scheduling.

WiMax is using OFDMA in the downlink and in the uplink. For the LTE (telecommunication), OFDMA is used for the downlink; by contrast, Single-carrier FDMA is used for the uplink since OFDMA contributes more to the PAPR related issues and results in nonlinear operation of amplifiers. IFDMA provides less power fluctuation and thus requires energy-inefficient linear amplifiers. Similarly, MC-CDMA is in the proposal for the IEEE 802.20 standard. These access schemes offer the same efficiencies as older technologies like CDMA. Apart from this, scalability and higher data rates can be achieved.

The other important advantage of the above-mentioned access techniques is that they require less complexity for equalization at the receiver. This is an added advantage especially in the MIMO environments since the spatial multiplexing transmission of MIMO systems inherently require high complexity equalization at the receiver.

In addition to improvements in these multiplexing systems, improved modulation techniques are being used. Whereas earlier standards largely used Phase-shift keying, more efficient systems such as 64QAM are being proposed for use with the 3GPP Long Term Evolution standards.

IPv6 support

Main articles: Network layer, Internet protocol and IPv6

Unlike 3G, which is based on two parallel infrastructures consisting of circuit switched and packet switched network nodes, 4G will be based on packet switching *only*. This will require low-latency data transmission.

By the time that 4G was deployed, the process of IPv4 address exhaustion was expected to be in its final stages. Therefore, in the context of 4G, IPv6 is essential to support a large number of wireless-enabled devices. By increasing the number of IP addresses available, IPv6 removes the need for network address translation (NAT), a method of sharing a limited number of addresses among a larger group of devices, although NAT will still be required to communicate with devices that are on existing IPv4 networks.

As of June 2009, Verizon has posted specifications[*dead link*] that require any 4G devices on its network to support IPv6.[29]

Advanced antenna systems

The performance of radio communications depends on an antenna system, termed smart or intelligent antenna. Recently, multiple antenna technologies are emerging to achieve the goal of 4G systems such as high rate, high reliability, and long range communications. In the early 1990s, to cater for the growing data rate needs of data communication, many transmission schemes were proposed. One technology, spatial multiplexing, gained importance for its bandwidth conservation and power efficiency. Spatial multiplexing involves deploying multiple antennas at the transmitter and at the receiver. Independent streams can then be transmitted simultaneously from all the antennas. This technology, called MIMO (as a branch of intelligent

antenna), multiplies the base data rate by (the smaller of) the number of transmit antennas or the number of receive antennas. Apart from this, the reliability in transmitting high speed data in the fading channel can be improved by using more antennas at the transmitter or at the receiver. This is called *transmit* or *receive diversity*. Both transmit/receive diversity and transmit spatial multiplexing are categorized into the space-time coding techniques, which does not necessarily require the channel knowledge at the transmitter. The other category is closed-loop multiple antenna technologies, which require channel knowledge at the transmitter.

Department Workshop: Department of Electronics and Communication IES, IPS Academy organized Two Week Workshop for faculties on "signal and Systems" under MHRD (NMEICT, IIT kharagpur) on 2 Jan. 2014 to 12 Jan. 2014

Student Achievements: The students of EC department are enthusiastic, energetic and active. They participated in sports, cultural events organized by IES and also by other institutes.

The students who secured positions in various activities organized under annual festival Voice of IES: 18th Oct. 2014 are

Voice of IES: 18th Oct. 2014

1. Suyash Jadhav got 1 position (EC) IIIyr.
2. HarshaThangwal got 2 positions (EC) I yr.

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