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Towards the 4th Generation Mobile and Wireless IP Networks

M.S. Zahrani
College of Computer Sciences and Information Technology
King Faisal University, Al-Ahsa, Saudi Arabia

Abstract: This study introduces the background history of 1G to 4G, compares the differences between 3G and 4G and illustrates how 4G may work more powerfully in future. The 4G has just been started. Besides, there are many technologies and standards which are still in the developing process. However, a general idea can be envisaged about 4G from academic research. The 4G evolution is based on 3G's limitations and it will fulfill the idea of World Wide Wireless Web (WWWW) offering more services and smooth global roaming with inexpensive cost. Recently, wireless technology is getting popular and gaining importance in the network field. The main goal was to design a flexible, scalable, single wireless system that is more practical, cost effective for mobiles and base-stations with characteristics required for future business and service growth. This study made an effort to delve deep and wide into the exposition of the fourth generation (4G) wireless network system.

Key words: 3G, 4G, IPv6, real wireless, world wide wireless web, mobile internet networks

INTRODUCTION

Presently, modern information outburst and codeless expertise insurgency caused enormous employment of codeless appliances for communique, business, learning, entertainment as well as business assignments. Enhanced by progression in semi-conductor expertise, mainstream codeless companies have offered clients or machines to call or connect from anywhere with a restricted statistical tempo less than several tens of kilobits per second. The informative wireless communiqué structures (for example, IEEE 802.11 WLAN, IEEE 802.16 Wireless MAN) are anticipated to present a variety of far reaching broadband utilities from elevated eminent voice to towering description video as well as international Internet admittance. The production of modern transportable configuration is moving and budding toward an all IP infrastructure. This will be instrumental in advancing versatile Internet Protocol attributes at the center structure. With the aid of relay-centered framework, codeless networks could present spine backhaul link utility or service protractions to minimize structure installation costs. Prospective utility structures will integrate coded as well as codeless ingredients and present customized multimedia utilities that are faultless universally. Alongside, widespread deployment of codeless systems, the performance disparities of IP flanking conventional coded networks and cordless interconnections are extensively studied and suspiciously inspected (Bellardo and Savage, 2003). Previously, the recognition of smart phones enhanced the fusion of computers, lattice as well as map-reading for position-sentient multimedia cell phone configuration devices (Steinke, 2008). The huddling course of action comes to an end in O (1) iterations, that is not dependent on the arrangement topology or magnitude. The modus operandi acquires stumpy visual projection with respect to dispensation succession and communications switch over.

NEW APPROACHES

The ubiquitous wireless infrastructures have significant impact on the modalities of communication. The advents of four generation (4G) have expertly metamorphosed the trends in wireless communiqué. Essentially, 4G configurations will prop-up mainstream infrastructures. Consequently, this is expected to present a vivid and indemnified Internet Protocol (IP) centered solutions where amenities the reminiscent of tone, statistics in addition to streamed multimedia will be presented to end users at anyplace, at anytime. Elevated statistical tempos in comparison to historical mobile brands will be achieved. The Motivations for 4G are as follows:

- Recent Researches have spectrally more efficient modulation schemes those can not be retrofitted into 3G infrastructure
- 3G performance may not be sufficient to meet needs of future high-performance applications like multi-media, full-motion video, wireless teleconferencing. Therefore, a network technology that extends 3G capacity by an order of magnitude is needed
- Wider bandwidth is needed
- 3G has multiple standards which make it difficult to roam and interoperate across networks. we need global mobility and service portability
- We need all digital packet networks that utilize IP in its fullest form with converged voice and data capability
- 3G is based on primarily a wide-area concept. So there is a need to have hybrid networks that utilize both wireless LAN (hot spot) concept and base-station WAN design (Table 1)

CHARACTERISTICS OF THE 4G

With respect to the affiliates of the fourth generation stratum, the system and the nodes of this technology exhibit the specifications which are executed from second generation to the fourth generation. However, bequest structures are in place to integrate mainstream end users. Implicitly, the 4G system will virtually be IP oriented. The divergent opinions propose the idea of incorporating an open internet podium. The Scientific advancement of the 4G

Table 1: Comparison of 3G and 4G

	3G	4G
Major requirement driving architecture	Predominantly voice driven-data was always add on	Converged data and voice over IP
Access technologies	W-CDMA, 1xRTT, Edge	All access convergence including:OFDM and MC-CDMA (Multi Carrier CDMA)
Speeds	Up to 2 Mbps	Up to 100 Mbps in mobile mode
Frequency band	Dependent on country or continent (1800-2400 MHz)	Higher frequency bands(2-8 GHz)
Bandwidth	5-20 MHz	100 MHz (or more)
Switching design basis	Circuit and Packet	All digital with packetized voice
Component design	Optimized antenna design, multi-band adapters	Smarter antennas, software radios multiband and wideband
Network architecture	Wide area cell-based	Hybrid-Integration of wireless LAN (WiFi, Bluetooth) and wide area
Services	Difficulty of global roaming	Roaming smoothly
IP	A number of air link protocols, including IP 5.0	All IP (IP6.0)

consists of Flash-OFDM, 802.16e network edition of WiMax popularly known as WiBro in South Korea and HC-SDMA. Some of the cardinal expertise used in 4G wireless technology includes are 1) Orthogonal Frequency Division Multiplexing (OFDM): This technology exploits the concurrency selective in conduit attributes, 2). MIMO: This gadget achieves extra towering spectral proficiency, 3). Turbo Principle: This device reduces the needed SNR at the terminal end and 4). Modulation: A device for longitudinal processing that consists of multi-tentacle and diverse-user MIMO (Engst and Fleishman, 2002).

COMPONENTS

Access Schemes

With the evolution of wireless infrastructures, the access method employed also demonstrates elevated proficiency, capability and scalability. The 1G wireless networks specification employed basic Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA). In wireless systems, TDMA showed to be least effective in accommodating towering information tempo channels as it demands volumetric case interludes to prevent numerous path effects. Conversely, FDMA utilized more bandwidth for safeguard to prevent inter transmitter disturbance. The 2G wireless networks utilized a combination of TDMA and FDMA devices as well as the Code Division Multiple Access (CDMA) which improved the network ability in terms of its information capacity. This allowed the 3G wireless network to use CDMA as the entrée design ISO-2000, HSXPA, TD-SCDMA and TD-CDMA. However, CDMA has inadequate spectrum flexibility. Previously, modern access schemes such as OFDMA, SC-FDMA and MC-CDMA gained significance in the 4G networks. For example, WiMax supports OFDMA both in the downlink as well as uplink. However, the UMTS and OFDMA are being proposed for downlink. In comparison, IFDMA is being touted for uplink because OFDMA enhances more to the PAPR associated themes and outcomes of non linear functions in boosters. The IFDMA presents minimal power changes and thus prevents booster issues. Consequently, MC-CDMA is the IEEE 802.20 suggested specification. These admittance designs present analogous efficacies as conventional expertise like CDMA. Far from this, scalability and elevated statistical rates can be realized. In addition, they need minimal composite for neutralization at the antenna (Engst and Fleishman, 2002). Figure 1 shows a simple graphical comparison of the three air interfaces.

IPv6 Support

The 3G is embedded on a two comparable systems comprising of circuit and packed plugged in configuration terminals. Correspondingly, the 4th generation wireless network is based on packet plugging that supports minimal-latency statistical dissemination. The

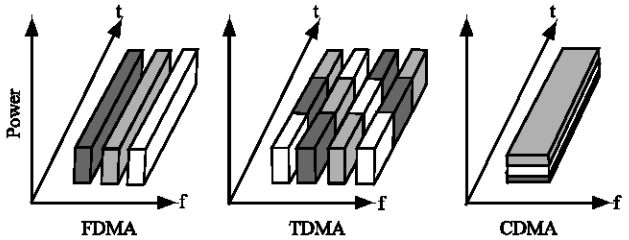

Fig. 1: Comparison of FDMA, TDMA and CDMA

process of IPv4, that addresses fatigue, is anticipated to reach the ultimate phase immediately after the 4G is set out. In this case, the 4G perspectives, IPv6 support is fundamental for sustaining huge numbers of codeless-enhanced gadgets. The IPv6 precludes the requirement for System Address Interpretation (SAI), especially when enhancing the numbers of IP addresses. This is a technique of allocating restricted figures of addresses amidst a huge cluster of appliances, even though SAI is an imperative technology that will be used on conventional IPv4 structures (Engst and Fleishman, 2002).

Advanced Antenna Systems

The representation of radio communiqué is essentially anchored on the advances of a tentacle structure known as intelligent transmitter. In the recent past multifaceted tentacle know-how has been emerging to realize the objective of fourth generation appliances. This includes elevated tempo, towering dependability and elongated transmissions. In bid to catering for the budding statistical rate specifications of data communiqué, myriad information dissemination techniques were proposed. Longitudinal multiplexing technology witnessed significance of sorts with respect to its ability to convert bandwidth and energy effectiveness. Longitudinal multiplexing technology is associated with rolling out of numerous tentacles at the booster and at the antennae. Distinctive strips can be relayed correspondingly from the entire tentacle. This enhances the statistical tempo into multifarious folds with the figure similar to the smallest broadcast as well as booster tentacle integers (Lowe, 2007).

Software-Delineated Radio (SDR)

It is an Unwrapped Wireless Infrastructure (UWI). Because fourth generation is a cluster of codeless specifications and the ultimate shape of a 4G appliance will comprise diverse specifications. This can be achieved proficiently by employing UWI expertise that is clustered to the region of radio junction.

Developments

The Japanese Corporation NTT DoCoMo has been experimenting fourth generation transmitting structure with 4 by 4 MIMO otherwise known as VSF-OFCDM at the rate of 100 Mb per second while in motion and 1 GB per second while static. The company accomplished the experiment by reaching an optimum packet deployment rate with an aggregate of 5 GB per second downlink supported by a 12 by 12 MIMO that runs on 100 MHz tempo bandwidth while in motion at 10 km h^{-1}. The company is planning to deploy the first business infrastructure by next year. Figure 2 shows the deployment rate.

4G Wireless Specifications

Technological advances have been spurred to upgrade the 3GPP specifications into a future 4G. This is being realized through the advancement of LTE. The experts on the ground have been evaluating several modalities for specification (Fig 3). In this case, LTE. has been earmarked as a section that will deploy 3GPP standards (Lowe, 2007).

New Technological Advancements

The wireless technology is a decisive ingredient of myriad client electronics artifacts, ushering connectivity to appliances and to punters. The 2009 International CES will unravel the latest ad-hoc technique and trends consisting advancements in position-centered services, next-edition Wi-Fi, mobile phones, smart phone in addition to mobile TV formats

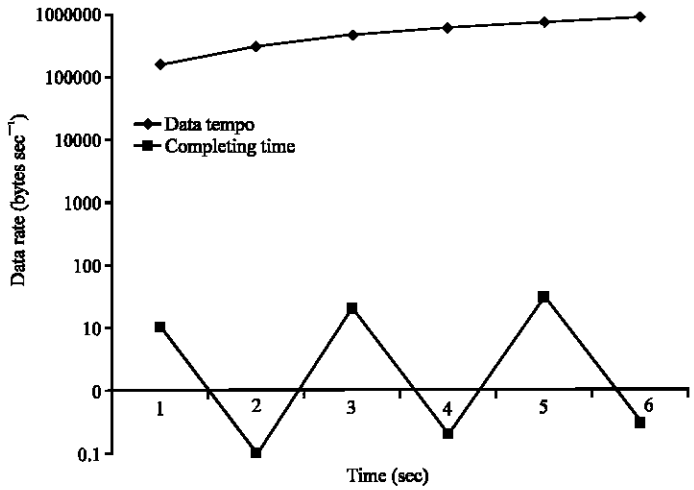

Fig. 2: Deployment rate

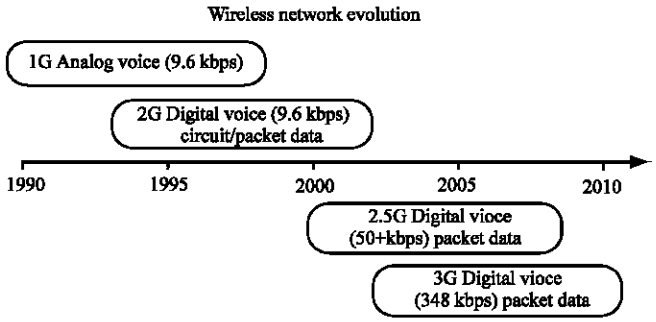

Fig. 3: The recent evolution of wireless networks

to meet competition from uprising individual communiqué services (PCS) systems as well as scheme-red satellite utilities, in addition to mainstream wireless carries and myriad start-ups. With these benchmarks, the prospects of wireless systems appear so glowing. The Giga in rank cluster of Cambridge, Mass, agrees (Lowe, 2007). It envisages the number of wireless statistics users will jump from less than a million today.

Off the cuff wireless networks reduce the intricacies of infrastructure connectivity, gadgets to design and join network. A wireless network comprises of terminals in a distinct system that entails diverse heterogeneous rings, stars and tree topologies. It is always significant that a network station must posse facets like transmission power, transmission costs and information delay and packet loss. These can be achieved by Incorporating Wireless LAN (WLAN) and even the WPAN (Wireless Personal Area Network). Wireless networking is a cost effective and a speedy mode of communicating with people in different geographical locations. Conversely, features such as compatibility emerge when using wireless networks. This means that different workstations from different end users are implausible to work in conjunction hence, extra work is need to connect them. Outstandingly, wireless networks are normally slow than the wired networks. In addition, wireless networks vulnerable such that intruders can enter the system and temper with the system (Kumar *et al*., 2008).

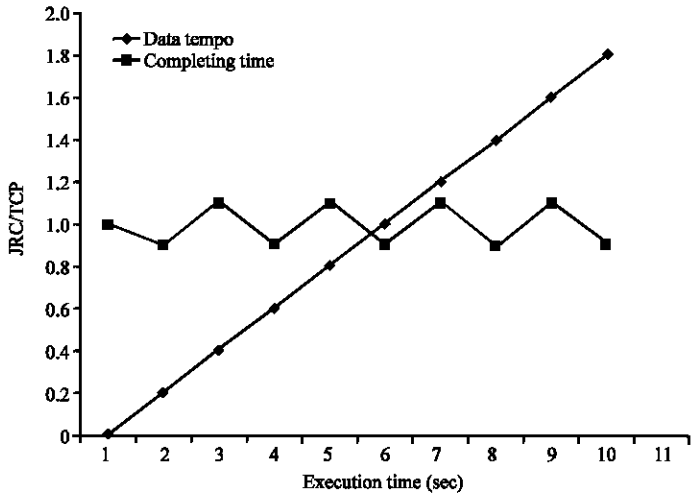

Fig. 4: Performance

Infrastructure and Ad Hoc Modes

A wireless system functions in one of two forms. In the ad-hoc approach, the position is a take in to the other class and relays unswervingly with divergent stations within the system. In this case no AP is associated. Each and every position can hurl signal and prod structure. The ad hoc mode position forms an Independent Basic Service Set (IBSS). A class in the system mode relays only with an AP. The Basic Service Set (BSS) is a cluster of positions that are logically related with each other and restricted by distinct AP. Jointly they function in a completely relate wireless system. The BSSID is a 48-bit integer of analogous format as a MAC address. This turf uniquely illustrates each BSS. The value of this domain is the MAC address of AP. Figure 4 shows the performance.

Authentication

Certification is the progression of demonstrating individuality of a posting to another location or AP. In the unwrapped structures, all positions are verified minus any checking. Position A relays an authentication control framework that constitutes the distinctiveness of A, to posting B. The position B relays with a frame that illustrates acknowledgment addressed to A. In the clogged classification blue print, the situation must discern the SSID of the AP in sequence to link to the AP. The communal key authentication employs a specification challenge and rejoinder along with a collective secret input (Lowe, 2007).

ASSOCIATION

Information can be swapped over among various positions and AP only after a position is related with AP in the structure mode or with succeeding position in the ad hoc component. All the APs convey inspiration structures a few periods each moment that include the SSID, moment, competence, prop up rates and other in sequence. Positions can choose to relate with an AP centered on the indicator vigor etc. of each AP. Positions can have an unacceptable SSID that is measured to contest all SSIDs. The connection is a two-step development. A terminal that is presently unauthenticated and unrelated eavesdrops for Beacon frame. The position chooses a BSS to join. The position in addition to the AP jointly substantiates them by interchanging confirmation control frames. The end

user is now confirmed, although not connected. In the subsequent phase, the posting hurls an Association Request frame, to which AP rejoins with a connection rejoinder request frame, to which the AP responds with a related rejoinder frame that includes an Association ID to the position. The position is now confirmed and connected. A position can be confirmed with various APs at the same time, even though correlated with at most one AP at any time. Connection underlies confirmation. There is not state where a position is related yet not verified.

Wireless Network Sniffing

Sniveling is eavesdropping on the systems. A package snivel is a system that interrupts and deciphers complex interchange relay through a means. Sniveling is the operation by an appliance S of constructing copies of a system packet sent by a system. Such sniveling, stringently speaking, is not a TCP/IP anomaly, yet it is enhanced by the choice of broadcast media, Ethernet as well as 802.11, as the corporeal and arithmetical connection stratums. Sniveling has for a long period been scouting method employed in coded systems. Prowlers whimper the frames ideal to augment the exploits depicted in anon phases. Blubber is the underlying method employed in gadgets that scrutinize the well being of a system. Blubbering can also assist find the easy slay as in inspecting for unwrap admittance positions that enhance anyone to connect, or capturing the secret codes employed in a connection session that does not run on a WEP.

New Results in Wireless Networking

Myriad of modus operandi have been adopted in the field of wireless networking to ensure that the users connect to the system despite their platform. Some of these protocols comprise of the internet protocol version 6 (IPv6), IPv4 and the 6HOP. The IPv4 is beneficial as it can be used by any common LAN like the 802.11 times wireless but the problem is that it cannot be catered for the increasing computer users and it is also slow hence, the engineering of IPv6 that is more secure and can accommodate many users (Gilbert, 2002).

On the other hand, 6HOP is very efficient in wireless networking due to it potent facets. In addition, the 6HOP system can be interconnected between the workstation and the user by mechanically hopping between the transitional network access points. Besides, the 6HOP has the ability to opt for the maximum itinerary in relation to users' requirements that is ideal operator, cost effective and power saving. Additionally, it can also acclimatize to circulation factors like fading and noise in every hop (Heltzel, 2003).

Techniques in Wireless Networking

Currently, wireless networking devices are gradually insightful in our daily life. Such that the wireless LAN has established the modalities of mobility in that information (Gupta *et al*., 2002) dissemination is not restricted to wire infrastructures which has contributed to emergency of new confronts and prospects like security to ensure there is no jam within the system and Denial of Service (DOS).Wireless networks are the targets of hackers because many companies have adopted them to ensure with considering their security measures (Wright, 2003).

Security methods in wireless networking consists of the WEB, VPN (virtual private networking), 802.1X, EAP (Extensible authentication protocol) as well as RADIUS (Remote Authentication Dial in User Service). These modus operandi have not fully resolved the safety bugs in wireless networking (Jon and Arbaugh, 2003). Nevertheless, there still exist troubles such as DOS in the security of wireless networking. A workstation that is DOS infected is at jeopardy of impinging on life, status and profits. That means a wireless network

for public use when it vulnerable users will not surf as a result the company providing such services will run into losses. Various studies have been conducted to incorporate diverse methods to promote the security of wireless systems by integrating gadgets which will help in the screening of load in wireless infrastructures, scrutinize hackers, blockade intruders and sustain an echelon of service to authentic end users (Weldlund and Schulzrime, 1999).

PROPOSED TECHNIQUES

VPN Technique

This means protects communiqué among remote areas by the internet such when a user with a wireless system uses VPN channel, the information remains encrypted till it gets to the gateways of VPN so that hackers are blocked from capturing communication infrastructures (Yi *at al.*, 2008). However, this technique is not self-sustaining that is both the end user and the client should have the VPA software (Bellardo and Savage, 2003).

WAP Method (Wi-Fi Protected Access)

This technique aims to modernize the susceptibilities by recycling the heritage hardware. WAP relies heavily on standards to ensure the eradication of myriad wireless networking security threats. In addition, it has adopted a key for information secrecy commonly called TKIP (key integrity protocol) (Engst and Fleishman, 2002).

Intrusion Detection and Inhibition Method

This technique involves detection and inhibition phases. The inhibition concept relies on the database from the hacker (IDB) designed during the detection stage. During this stage, when user submits a packet that require authenticity he/she is first checked against the IDB and if found among the enlisted the access is denied. The idea of inhibition detection is based on verification protocols (Jamil, 2003). In that a wireless system user using the network has oblige to the confirmation information to access the system and if what the user has does not match with information in the AP (access point) he or she is considered a hacker and the access is denied. Yet still, this technique is not accurate because a wireless user can be having the authenticity to access the network and sometimes erroneously enters wrong codes the user will be automatically denied entry into the system and be considered an intruder (Atul *et al.*, 2004). In a nut shell, this technique involves; user requesting entry into the wireless system, AP confirms if the client is in IDB, if the user is enlisted in the IDB he or she is denied access and if not verified to the next step which is endorsement if the information entered is similar with what is in the data base; then the client is certified to complete the process tat is use the system (Bellardo and Savage, 2003).

Handoff Architecture

This method has two layers i.e. the information link and physical. The physical layer has the velocity evaluation and RSS unit. The Information link has the neighbor discovery and the handoff signaling evaluation unit. The data is gathered from the physical and the information link to carry out the handoff procedures, handoff trigger unit and handoff completing unit (Atul *et al.*, 2004). The neigbouring discovery unit supports the itinerant terminals to understand the operations of neighboring terminals by the use of candidate access route discovery protocol to identify and discover the surrounding terminals (Liebsch *et al.*, 2004). The handoff signaling delay unit evaluates the delay related to the intra network and inter network. The velocity evaluation unit approximates the movable rate using the speed evaluation power spectral mass. The rate of user of the wireless network is

associated with the velocity of the mobile client (Zhang and Holtzman, 1996). The handoff trigger unit deals with the collection of data from the handoff signal delay unit, velocity evaluation unit, RSS unit and also verify the suitable time to begin handoff measures. In short, handoff infrastructure uses the information link and data from the wireless system layer to initiate and manage the security system of wireless network. This infrastructure relies on the movable velocity and handoff signal delay unit as the main source of data.

WI-Max

This technique has a standardized connectivity based on the fixed areas. The method is high rate of information dissemination, high velocity and covers large areas approximately 30-miles. Figure 5 shows the peak and average sector throughput for Wi-MAX. It can be seen that the average speed of downloading is approximately 30 Mbps of shared bandwidth available for download transmission per sector using a 20 MHz channel (similar to IEEE 802.11 g average throughput). For instance, if there are 10 users connected to the network using the same sector and if 5 users are downloading data at the same time, then each user will receive approximately 6 Mbps average download throughput. Note that the quality-of-service mechanisms have been sophisticated by Wi-MAX which will help to equitably regulate per-user performance.

CONCLUSION AND RECOMMENDATIONS

It is anticipated that new edition of wireless structures will present a mammoth aspect of multimedia utilities to the itinerant clients. The modern codeless metropolitan region system (Wireless MAN) and progressed Codeless LAN system have the capacity to present broadband Internet utilities with broadcast tempos of about 54 Mbps and above. Future wireless interconnections will be extensively deployed either in backhaul links for back bone or last leap interconnections for undeviating itinerant end user entrée. Upcoming multimedia applications will require a rate control scheme to protect the fair Internet supplies and circumvent preventable communication diminution due to wireless loss. Nevertheless, mainly the accessible solutions of equation-centered tempo control for wireless interconnections support the codeless-link parameters and may not function healthier in such a crossbreed connection. In this study, we have reviewed widely about wireless systems. The divergent handoff techniques are inherent within the TCP/IP technology procedure. On top of that, the energy-efficient disseminated grouping line of attack for off the cuff sensor systems were discussed at length. Present target was to design a flexible, scalable, single wireless system that is more practical, cost effective for mobiles and base-stations and with

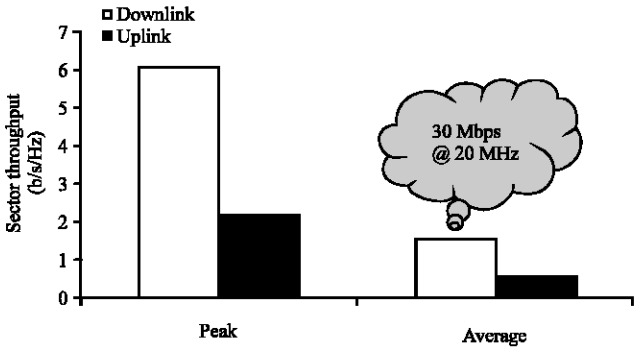

Fig. 5: Mobile WiMAX throughput (Source: Intel)

characteristics required for future business and service growth. However, future holds a lot on the new expertise in the wireless domain. Much more research is therefore necessary if novel devices are to be invented.

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