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Telecom:
Enabling growth and serving the masses

"A 10% increase in mobile and broadband penetration increases the per capita GDP by 0.81% and 1.38% respectively in the developing countries."

World Bank

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Foreword

Over the past decade, Indian telecom industry has witnessed many positive developments. India has attained the second largest subscriber network after China with the total number of subscribers scaling up to about 900 million and claiming an urban teledensity in excess of 140 and rural teledensity of 40. With an estimated base of 67 million smartphone users in 2013, India also ranks fifth amongst the top countries in this category. With an increasing smartphone penetration in the country, subscribers accessing internet through mobile devices stand at 176.50 million.[1]

India has achieved a lot in telecom in terms of accessibility and connectivity throughout the country. However, lack of quality healthcare and education and non-availability of banking to masses have been major hurdles in inclusive socio-economic growth of the country.

The healthcare sector, for instance, is severely lacking in terms of infrastructure and professionals. India has only 12 beds, 13 nurses and 6 doctors per 10,000 persons.[2] Given the scenario, improvising the accessibility and affordability of healthcare stands out as a huge challenge.

Despite significant growth in the banking sector, it remains elusive for many people in rural India. Indian banking sector has intense competition between domestic and foreign players, which compels them to adopt innovative strategies towards customer loyalty. However, it is only an urban phenomenon. Financial inclusion through economically viable solutions so as to increase the rural presence of banks, use modern technology for greater information security and lower transaction costs, is an arduous objective for the banking sector.

Education, on the other hand, is a fairly underdeveloped sector, with lack of quality education and high dropout rate. It is difficult to deliver education in remote areas and enforce the Right to Education (RTE). Girls, the socially excluded and the marginalized need to be included.

In addition to these sectorial challenges, there is serious concern around fast urbanisation (31.16% per 2011 Census), which is cascading other problems. Growing urbanisation has led to lack of public services, inadequate infrastructure, congestion, pollution and impoverished living standards for most fast-growing Indian cities. Within next 20 years, another 300 million people might get added to towns and cities. This expansion will cause huge stress on the various systems. The country loses almost ₹600 billion annually due to congestion (including fuel wastage), slow speed of freight vehicles and waiting time at toll plazas and checking points.[3]

Since mid-2000, online and telephone services have become a mainstay of many sectors and most of them have incorporated these into their core services; thus reducing the cost of physical infrastructure, increasing reach and transforming the delivery of services. Advanced contemporary offerings like tele-presence, e-learning, tele-medicine and direct banking are changing the business paradigms across industries and helping to bring down the carbon footprint. To expand these telecom-based services, high industry investment and involvement is vital.

To every problem there is a solution, thus challenges faced by the social sectors can be tackled through telecom technologies by mirroring the advantages of physical infrastructure/branches. This report aims to discuss the role of telecom in enabling growth of various sectors such as healthcare, banking, education, energy and serving the masses, at large.

Hemant Joshi

Overview of the telecom sector

Telecom: The big picture

Globally the telecom industry is in the midst of a transformational shift, driven by a huge surge in data traffic on telecom networks. A number of mobile operators are rolling out 4G networks across the globe. A number of wireline operators are rolling out "Fiber to the home", providing enormous bandwidth up to 100 Mbps to the subscribers. Users will be able to gravitate to fastest, most reliable and best priced wireless networks available. The migration of speed seeking data users to 4G may be accompanied by a rise in volume of voice calls on legacy 2G and 3G networks. Operators are offering very competitive tariffs to encourage more of their subscriber base to use mobile data services. 4G customers are likely to generate higher Average Revenue Per User (ARPU) than 3G customers.

There are about 6.9 billion mobile connections globally, which are growing at an annual rate of 7.36%. The ARPU is stagnating to around $24.6 while Minutes of Use (MoU) show an upward trend around 296 per connection. 4G had only 2.85% of the world market penetration at the end of 2013 while 3G had that of 28.45%.

Globally, the governments are making more spectrum available to exacerbate the spectrum shortage. More and more mobile operators are deploying emerging technologies such as HetNets to overcome the spectrum exhaustion.

India, the second largest telecom market by subscriber base after China, witnessed phenomenal growth in last decade. The 2G scam leading to cancellation of a spate of licenses, high competition, heavy debt and flip-flops on regulatory and other policy issues in recent years, have taken a heavy toll on the sector, hurting the profitability of companies.

The total subscriber base[4] as of June 2013 was 903 million vis-a-vis 22.8 million total subscribers in 1999. Mobile subscribers accounting for 96.7% of total subscriber base are responsible for this phenomenal growth in telecom. The country has achieved overall teledensity of 73.5, urban teledensity of 145 and rural teledensity of 42. Average revenue per user (ARPU) and Minutes of Usage (MOU) are stabilising for both GSM as well as CDMA service operators. Monthly ARPU for GSM services increased by 6.14% from ₹105 in March

2013 to ₹111 in Jun 2013, with year-on-year increase of 16.73%. On an all India average, the overall MOU per subscriber per month for GSM services increased by 1.38% from 383 in QE March 2013 to 388 in QE June 2013. Gross Revenue (GR) and Adjusted Gross Revenue (AGR) of Telecom services sector for QE June 2013 has been ₹572.60 billion and ₹386.40 billion respectively. There has been an increase of 5.48% in GR and 9.53% in AGR as compared to previous quarter. Wireline broadband subscriber base witnessed major growth with number of subscribers around 21.89 million.

The operators have been focusing increasingly on data and value-added services apart from cutting costs through innovative business models. Operators are sharing passive infrastructure resulting in lower OPEX and CAPEX. They are now looking to share active infrastructure.

Telecom: The story so far

As is the case with several developing countries, India also launched its market oriented economic reforms in 1991. The country at that time was facing twin economic crisis i.e. unmanageable balance of payment situation and high rate of inflation. The then Prime Minister converted this economic crisis into an opportunity to launch massive economic reforms and the country in 1991 initiated path breaking economic reforms, radically departing from the economic policies and regulatory framework, which the country had been pursuing since independence. The country decided to emulate the success of Japan, South Korea and South East Asian economies by having export-oriented and globally connected economies. The East Asian development model had been remarkably successful in achieving high growth rates, at the same time raising the living standards of the people, in relatively short period of time. India was also looking at replicating the same results from these reforms.

Following these major economic reforms, the country also focused on developing national infrastructure; consequently the country's economic growth progressed at a rapid pace, with relatively large increase in the per-capita income. As a result of economic liberalisation, India's GDP has been rising by more than 7% annually in the past decade, compared to 3.5% annually from 1950 to 1980. The Indian economy maintained a growth rate of more than 5% even during the global recession.

India's service sector accounts for roughly 55% of GDP. Within the services sector, the telecom sector has been the major contributor to the country's growth, accounting for nearly 5.3% of the total GDP in 2012.[5]

Subscriber base and teledensity in India had been abysmally low during the time Government had the absolute monopoly for providing telephony services. Liberalisation in telecommunication services began in 1992, with the deregulation of telecom sector. The Government allowed participation of private sector for cellular and paging services. India faced challenges in liberalising its telecom industry, from being a government-owned monopoly to an industry with active private sector participation. The National Telecom Policy 1994 (NTP 1994) was formulated for the purpose of opening up the Indian markets for Foreign Direct Investment (FDI) as well as domestic investment in the telecom sector. The main objectives of the NTP 1994 were (i) telephone to be available on demand by 1997(ii) all villages in India to have access to basic telephone services by 1997 (iii) provision of a PCO for every 500 persons by 1997, in urban areas. Thus the main goal of the NTP 1994 was to increase the accessibility to telecom services.

Entry of private sector in Telecom didn't happen to government's satisfaction, as envisaged in NTP 1994; consequently there was little improvement in teledensity.

Private operators and investors had concerns on the viability of the business and return on investments. To address the concerns of private sector, government issued a New Telecom Policy in 1999 (NTP 1999). Government also realised that if India has to become an IT super power, the country must have world class telecom infrastructure, therefore, there was a need to develop a new telecom policy framework.

The salient features of NTP 1999 were:
(i) To introduce greater competition in the telecommunications sector
(ii) To provide equal opportunities and level playing field for all players
(iii) And to make available affordable and effective communications for the citizens.

Some of the objectives set forth by government under NTP 1999 were fulfilled. Targets on overall teledensity, rural teledensity and telecom coverage for villages were achieved. Target on tariff structure were also achieved as India has lowest tariffs in the world and target of providing high speed data links to all towns having population of more than 200,000 was also achieved. Few targets such as achieving transparency in spectrum management, providing internet access to all district headquarters and reliable media to all exchanges by year 2000 were missed. Nevertheless, NTP 1999 continues to be the policy matrix guiding telecom sector till date.

Achieved

> Teledensity of 7 by 2005 and 15 by 2010.
Acheived 78.5 by June 2013
> Making tarrif structure more affordable.
Lowest tariffs in the world
> Increase rural teledensity from 0.4 to 4 by 2010.
Achieved rural teledensity of 41.9 by June 2013
> Achieve telecom coverage of all villages.
Achieved coverage of 97.6% by June 2011
> High speed data and multimedia capability provided to all towns with a population greater than 2 lakhs.

> Strengthen R&D efforts and provide an impetus to build world-class manufacturing capabilities.
> Achieve efficiency and transparency in spectrum management.
> Provide reliable media to all exchanges by 2002.
> Encourage development of telecom facilities in remote, hilly and tribal areas of the country.
> Sector releated skill development.
> Broadband penetration.

Underachieved

Source: NTP 99 and Draft NTP 2011 policy

Telecommunication has been recognised world-over as an important tool for socio-economic development of a nation and has a defining role in growth and modernisation of various sectors of the economy.

India became one of the fastest growing telecom markets in the world. The unprecedented increase in teledensity and sharp decline in tariffs in the Indian telecom sector have contributed significantly to the country's economic growth. Besides contributing about 5.3% to India's GDP, Telecommunications along with Information Technology has greatly accelerated the growth of the economic and social sectors. Against this backdrop, the National Telecom Policy 2012 (NTP 2012) was conceived, with the vision to transform the country into an empowered and inclusive knowledge-based society, using telecommunications as a platform.

According to a World Bank study, a 10% increase in mobile penetration is known to boost per capita GDP by 0.8% points in developing nations. According to a study by the Indian Council for Research on International Economic Relations (ICRIER)[6], states with a higher teledensity have grown faster than those with lower teledensity. States with 10% higher teledensity have grown 1.2% faster. For instance, Bihar could have witnessed 4% faster growth if it had enjoyed the same teledensity as Punjab. An efficient telecommunication services network facilitates smooth information flow which could result in lower transaction costs.

Driving broadband growth

Equally significant is the fact that broadband penetration in India stands at just 1%, rural teledensity at 42. Department of Telecommunication in India has planned to increase rural teledensity from 40 to 60 by year 2017 and 100 by year 2020. Moreover, the National Broadband Plan envisages 160 million broadband connections including 60 million wireless broadband connections by the year 2014. There are plenty of opportunities for the communication service providers in India to address this growth path.

Government of India has approved building of National Optical Fiber Network (NOFN) to provide connectivity to 250,000 Gram Panchayats of the country. The project envisages providing high-speed and high-quality broadband access to all village panchayats through optic fiber by year 2014 and progressively to all villages and habitations. National Telecom Policy 2012 has set a target of 175 million connections by 2017 and 600 million connections by 2020 at minimum 2 mbps speed and higher speed up to 100 mbps on demand. This will help the Government to ensure equitable and inclusive growth if acheived.

One of the objectives of NTP 2012 is to provide high speed and high quality broadband access to all village panchayats through a combination of technologies by the year 2014 and progressively to all villages and habitations by 2020. This will enable citizens to participate in and contribute to e-governance in key sectors like health, education, skill development, employment, governance, banking etc. to ensure equitable and inclusive growth. The thrust of the NTP 2012 is on the multiplier effect and transformational impact of telecommunication and broadband services on the overall economy. It recognises the role of such services in furthering the national development agenda while enhancing equity and inclusiveness. It

provides the enabling framework for enhancing India's competitiveness in all spheres of the economy. NTP 2012 envisages support to platform-neutral services in e-governance and m-governance in key social sectors such as health, education and agriculture that are currently limited to a few organisations in isolated pockets. This will expand the footprint of these services and thus foster an atmosphere of participative democracy delivery model, which is truly citizen-centric, ensuring equitable and inclusive development across the nation.

In less than a decade, the mobile phone has become an essential item of day to day usage in the life of an average Indian. The easy access to mobile services is on account of low tariffs and affordable handsets. A positive regulatory regime, competition among mobile service providers and significant investment in telecom infrastructure has contributed towards improvement in teledensity across the country. In fact, a mobile handset or a wireline telephone instrument is no longer a mere communication device; it has the potential of being an instrument of empowerment. This would be made possible through ubiquitous network connectivity of mobile technology, broadband Internet, fibre penetration in all villages, low-cost affordable devices and software solutions, which enable electronic access to various services including m-payment. A unique AADHAR-based electronic authentication framework would be integral part of providing service to the people. Cloud computing will significantly speed-up ability to design and roll out services, enable social networking and participative governance and m-Commerce at scale, which was not possible through traditional technology solutions. As per GSMA, the global business impact of connected devices could be $4.5 trillion by 2020. One of the strategies of NTP 2012 is to promote synergies between roll out of broadband and various Government programs viz e-governance, e-panchayat, MNREGA, National Knowledge Network, AADHAR, Aakash tablet, etc.

Countries all over the world, are increasingly taking advantage of the opportunities being created by telecommunications and other technologies. India needs to catch up fast to join the ranks of emerging economies that have made or are in the process of making the transition to middle income level economies. Countries having higher teledensity and deeper internet penetration are driving innovation and more sustainable

economic growth. Only 5% of the Indian population uses internet regularly. At this level of internet penetration, it would be difficult for India to make transition to middle income level economies.

Mobiles have the potential to enhance the income level, generate employment opportunities and improve livelihoods of SMEs, sole traders and people running small businesses. However, there are bottlenecks such as education and teledensity particularly in rural areas. Telecommunication has emerged as a key enabler of economic and social development but it cannot be seen in isolation from other parts of the development process. Access to mobile telecommunications is certainly not the only thing that is crucial to economic growth. Unless other infrastructure and complementary skills are in place, all round economic development will not be realised. There is no benefit in farmers knowing the prices that their produce could be sold for in different markets, if the road network to transport their produce to those other markets is poor or non-existent. Mobile telephony does have an important role to play, as it provides a means for the exchange of information and learning, but it is only one element in the process of productivity growth. Therefore, access to telecommunications needs to be seen as a foundation on which other initiatives can be built.

Addressing the rural challenge

India's mobile service providers (MSP's) have yet to tap the full potential of rural India, as large parts of rural India are in dire need of telecom services. Bridging the rural-urban digital divide is critical for India's inclusive growth in financial, healthcare and education sector, among others. The challenge, however, is to deliver a mobile service to rural users, that is viable and profitable at the current low levels of ARPU.

Notwithstanding the economic progress over the last decade, the digital divide in the country continues to be significant. Expansion of telecommunications in the rural areas has been slow as compared to urban areas, with the former accounting for only 39.6% of the total connections. In addition to this, there is wide variation in teledensity from one state to the other. States such as Punjab, Kerala, Karnataka, Tamil Nadu, Gujarat, and Maharashtra have higher teledensity in the range of 87% to 109% vis-à-vis states such as Bihar, Uttar Pradesh, Madhya Pradesh and Assam having teledensity in the range of 44% to 55%.

PURA: "Providing Urban Amenities in Rural Area"[7]

As articulated by Dr. Abdul Kalam, the word PURA has become widely used in social economic system for sustainable growth. PURA stands for a well-planned drive towards achieving an inclusive and integrated development starting at the village household level. PURA involves following:

• Physical Connectivity
• Electronic Connectivity
• Knowledge Connectivity
• Economic Connectivity

Physical Connectivity: This refers to the infrastructure such as schools, colleges, hospitals, irrigation network and amenities for the local population. Physical connectivity would facilitate the movement of goods and people, thereby, enabling enterprises to have a wider access to their inputs, markets or intended beneficiaries. A network of roads or seaways with proper traffic management would connect enterprises with their suppliers and buyers and bring down the time and cost of transport.

Electronic Connectivity: Villagers must have access to good education from the best teachers, the benefit of good medical treatment and the latest information on their occupation such as agriculture, fishery, horticulture and food processing. Electronic connectivity can make this happen. Electronic connectivity is essentially a facilitator to help create knowledge networks, enhance educational initiatives, connect hospital and remote locations, bring in better banking services and open up market access in a faster and more transparent manner.

Knowledge Connectivity: Once the physical and the electronic connectivity are enabled, the knowledge connectivity has to be set up. This can facilitate an increase in productivity, and spread awareness for health and welfare. Some of the important functions performed by knowledge connectivity include:

• Distance education
• E-Health care
• Soil and fertilizer management
• Agro-processing technologies
• Mapping of land, water and other resources
• Environment & forest management
• Weather management
• Any special local or seasonal needs

As PURA matures, knowledge connectivity itself will enable the creation of knowledge-service enterprise, providing value addition to the lives of the local people.

Economic Connectivity: Establishing physical, electronic and knowledge connectivity will facilitate economic connectivity in the area. Economic connectivity will lead to the creation of employment, entrepreneurship and income augmentation in the rural areas through the setting up of agro-based, manufacturing and services industries. PURA complexes strive to be economically independent and contribute to the economic growth of the nation in a positive manner. Economic connectivity model needs customisation in terms of:

• Quality of human resources
• Specialised skills
• Special competencies
• Connectivity to the markets and cities and within the villages
• Support industries etc.

"Providing connectivity to villages is an urgent need to bridge the rural-urban divide, generate employment and enhance rural prosperity. The integrated method which will bring prosperity to rural India is through PURA."

Dr. APJ Abdul Kalam
Former President of India

As the income of the rural population rises, there would be a corresponding increase in the disposable income level. Some part of it would initially go towards better and more food, but a larger and increasing share would go into non-food expenditure. This would create an opportunity for economic activities based on a demand for local services as well, generating further employment activities.

Putting a mobile in the hands of an individual engaged in agriculture, by itself is unlikely to improve that person's livelihood; there must be investment in other complementary infrastructure. Poverty ultimately needs to be alleviated by improved labor productivity.

Conclusion

India is a country of billion plus people with problems of non-availability of clean drinking water, sanitation, basic healthcare, primary and higher education, housing, roads, banking facilities etc. for the masses.

The sheer magnitude of the problem is daunting. Given the geographical spread and disparate levels of infrastructure development, reaching a billion plus population and ensuring equitable distribution of basic amenities / services is a challenging task. Fulfilling the key needs of the people such as clean drinking water, sanitation, education, basic healthcare is a pre requisite for propelling the economy to a higher growth trajectory.

Technology cutting across all sections and strata of society is a great enabler for growth. India has the opportunity to take its growth story to the next level and achieve a sustainable basis by leveraging telecom technology to the fullest. This following chapter discusses some of these aspects.

Global Trend

Google Fiber: It is a fibre-to-the-premises (FTTP) service launched by Google to provide broadband internet and television at 1 Gbps speed. This FTTP trend is fast picking-up across the world as fibre configuations can provide highest speeds and are considered "future proof".

Telecom
spreading
Education
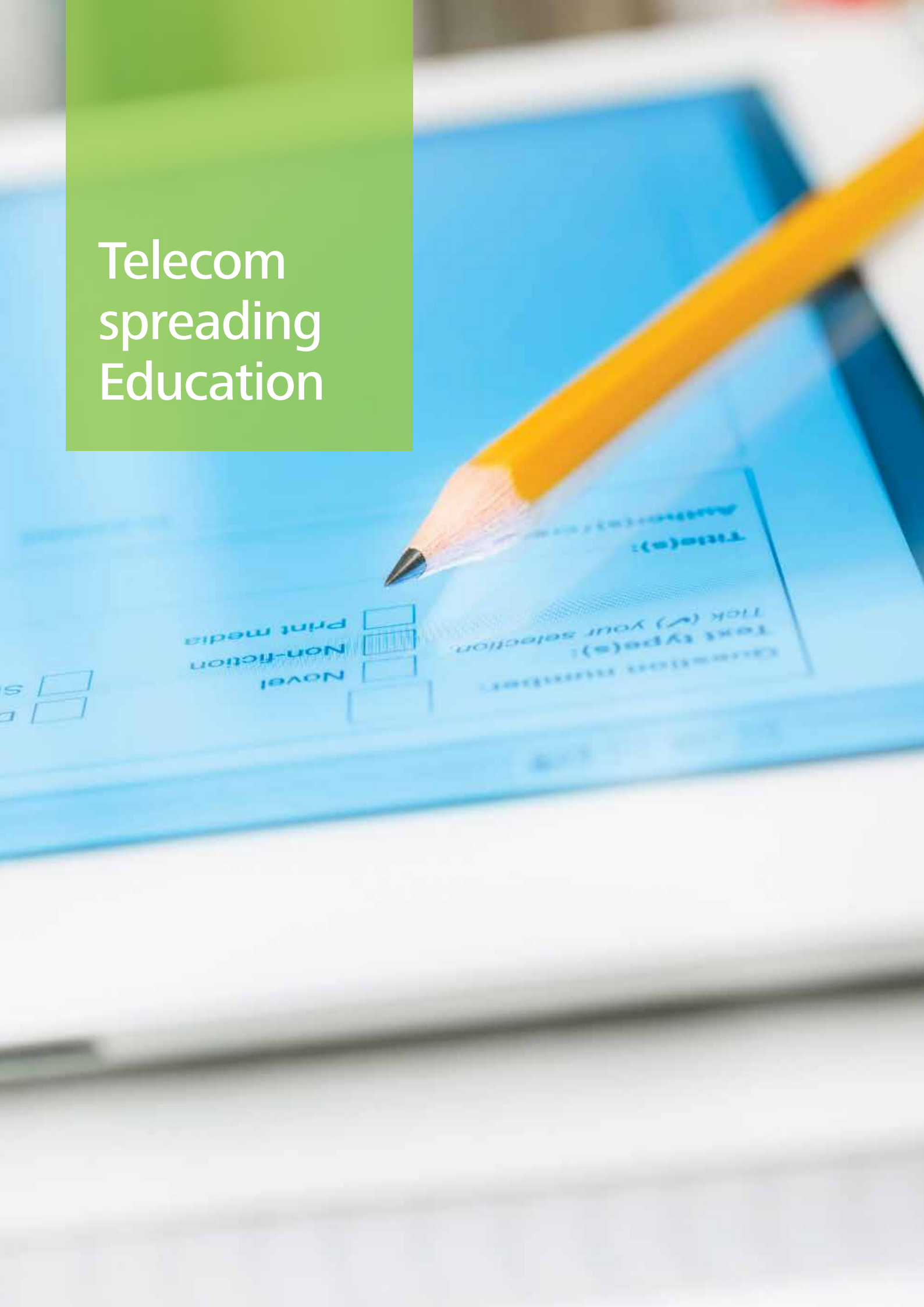
The market size of Indian education sector is expected to increase to ₹6024.1 billion by FY15.[8] According to the 2011 census, the total literacy rate in India is 74.04% compared to the world average of 83.4% (2008). India's Gross Enrolment Ratio (GER) in higher education is only 15% and lags behind much of the developed world as well as other developing countries. Half of India's rural government schools don't meet the prescribed pupil-teacher ratio (PTR) norms mandated by the Right to Education (RTE) Act and only 3.7%

"Education manifests itself in many ways like cognitive thinking, affirmative thought system. It brings well-being to society. Mobile technology based education will develop necessary scientific temperament and acumen in masses for excelling in fields of Innovation, Research and Development."

Dr. Sunil Karad
Executive Director, MIT Group of Institutions

meet the seven mandated infrastructure norms[9]. Lack of infrastructure, qualified teaching staff, substandard facilities are some of the hurdles that must be overcome, if the country has to achieve the goal of 100% literacy. Three challenges highlighted by Knowledge Commission of India are[10] :

Expansion: Although India has extensive infrastructure for education, it has failed to develop a base of highly trained human capital due to high dropout rate and students hailing from marginalised communities, which have largely remained excluded.

Excellence: Dated syllabus, examination-oriented focus, monotonous classroom study, communication gap between teacher and student, are detrimental to the quality of education and hinders the development of excellence in education.

Inclusion: Overcome gender bias and provide equitable education regardless of gender, caste, disability.

Education is the foundation on which rely the wellbeing, economic wealth and social prosperity for any society. The Constitution provides for free and compulsory education of all children in the age group of six to fourteen years as a Fundamental Right. The Right to Education (RTE) Act provides for the right of children to free and compulsory education till completion of elementary education in a neighborhood school.

Sarva Shiksha Abhiyan (SSA) operational since 2000-2001, provides for a variety of interventions for universal access and retention, bridging of gender and social category gaps in elementary education and improving the quality of learning. The problem of access can be overcome, through the innovative use of telecom technology. There is a great deal that can be achieved in imparting education to all if telecom access is available.

Telecom enabled access to education

Telecommunications can facilitate access to education in the remote areas; improve subject coverage as well as delivery. It can help students in accessing the content directly. Telecommunications can help teachers in developing their skills and knowledge. Teachers in remote villages have the most pressing requirement for in-service training, continuous upgradation of skill sets, and training to use new technology and instructions on teaching the new curricula. The communication technology of the internet/intranet WAN and video/audio tele-conferencing can support this ongoing instruction and training requirement of the teachers. Telecommunication can also help a great deal in improving adult literacy.

Distance or distributed learning programs have been the driver of bringing a wide array of new technologies such as broadcast, wired communication to the classroom. Information & communication technology has made delivery of interactive learning possible, anytime, anywhere by combining voice (audio), video

and data (text and graphics). Radio and broadcast television media has been in use for expanding the reach and delivery of education. Print media has been the basis of delivery of correspondence courses. These delivery mediums are one-way methods and can be upgraded to two-way delivery methods. The two-way methods are computer and network-based, interactive multimedia based, combining voice, video, data (in text and graphics). The two-way methods offer the greatest opportunity to provide higher quality education to a wider population.

Figure 1: Telecom tools

One way, non-interactive	• Broadcast radio: e.g. All India Radio broadcast farmer education and teacher education programs. Nepal and South Africa have programs for kindergarten teachers and care givers. • Broadcast television: Doordarshan broadcast NCERT & UGC programs in India. British Open University higher education on TV is a model for mega-universities in developing world. • Satellite TV: TV transmission in India is through terrestrial as well as satellite link. NCERT and UGC programs are broadcasted through terrestrial as well as satellite uplink. • Satellite Radio: As of now there is no satellite radio broadcast in India. This medium can be utilised for one way non-interactive transmission. • Video and Audio Tapes: United States Agency for International Development (USAID) is one of the organisations that has used this medium, for rural health education programs.
One way, interactive	• Interactive Radio Instructions: The OLSET program in South Africa was launched to teach language and mathematics to primary school children. The radio programs were produced in South Africa and print materials were prepared in conjunction with the radio programs. • Web casting courses with interactive multimedia, streaming audio & video • CDROM with interactive multimedia courses • Read only information sources e.g. on-line journal archives
Two-way, interactive	• Satellite two-way access to the Internet • Video conferencing in various formats • Interactive multimedia with video conferencing window, shared whiteboard & applications • Audio conferencing by telephone conference calls with high quality audio conferencing equipment with service provided by national and international carriers. It could be used for discussion seminars, lectures with keypad response, and support sessions for teachers. • e-mail, computer conferencing, file transfer and other one-to-one or one-to-many data exchanges • Widely shared information resources, e.g. shared databases

Source: Regency[11]

The Emerging promise of mobile education

Despite rapid economic growth, India still lags behind on key development indicators – financial inclusion, basic health, education etc. With mobile penetration expected to reach 100% by 2015 and availability of a pan India 3G network, mobile value added services(MVAS) can be deployed to provide efficient access to essential information and services and foster inclusive growth. The reach and penetration of mobile phones can ensure the delivery of a large number of services in a cost effective, fast and seamless manner even without physical access. The price of mobile devices is coming down and these devices are capable of supporting powerful applications, which empower the user in a variety of ways, from exchanging information via SMS, accessing entertainment-based services to checking bank account details, crop prices, receiving personalised health alerts and obtaining vocational training.

M-education one of the service within the gamut of mobile value added services, represents a paradigm shift in the way education is delivered and received. M-education can provide education anytime anywhere, overcoming the time and space constraint of traditional classrooms. Significant progress can be made towards achieving 100% literacy by leveraging the rising penetration of mobile phone and MVAS.

Improving access to education[12]: Mobile network today covers almost 90% of global population. This has created an unprecedented opportunity for learners all over the world. Learners now have access to content and teachers. "English Seekho" (Learn English) one of the service offered by Tata DoCoMo, allows users to take conversational English language lessons on their mobile through an interactive voice response application. BBC World Service Trust and BBC Learning English are implementing the Janala project in Bangladesh. The Janala project provides English language lessons to citizens via their mobile phones. In Canada, University of Waterloo teachers deliver lessons through podcasts that students can access anytime, anywhere and allowing them to learn at an independent pace.

Personalising education delivery: All students in a group do not learn at the same pace. Teachers are not able to respond to difference in pace and learning styles of students in traditional class rooms. Mobile technology allows customisation of instructions and adjustment of difficulty levels by tracking responses to several different questions. Mobile technology facilitates students creating / sourcing their own content, sharing with classmates / teachers and inviting their comments.

M-education addressing the challenges of education system[12]

The focus of the authorities in developing world is to ensure access to basic education and improving teacher quality. The developed world on the other hand is striving to improve student engagement and customising education for each learner. The challenges can be divided in following broad categories:

- Lack of access: The widespread penetration of mobile networks offers a powerful platform to improve access to relevant and high quality content, which otherwise is a key challenge in the developing world.
- Untrained teachers: Another challenge in developing world is undertrained teachers not being able to contribute meaningfully to learning process. Mobile technology is providing access on best practices to educators.
- Absence of tailored approach: Inability to adapt teaching styles to match the pace of learning and preference of learners is one of the drawbacks of group learning. Online learning is highly flexible, adaptive, interactive allowing contents to be delivered to individual learning pace and style, helping students to learn and understand better. Telefonica Spain offers a web-based solution "Aula365", allowing students the flexibility of choosing instructional media such as video / graphics for learning, enhancing understanding and deepening engagement.
- Infrequent evaluation and feedback: M-education supports regular assessment and feedback, which helps teachers to evaluate the student understanding and identify the areas where they need support, which teachers are unable to do regularly in traditional class room environment.
- Absence of data to benchmark students' performance: M-education is flexible and allows teachers to confidentially track and benchmark students' performance across multiple parameters, thereby providing a far richer assessment of student's performance.

M-education products and services landscape[12]

M-education services / initiatives globally span across following broad categories. Each type of M-education product addresses the challenges in the current educational system.

- **Educational e-Books and e-Courses:** These are accessed through portable devices. More and more educational content is getting digitised and consumers are accessing and learning through their mobile phones. Publishers worldwide are either producing e-books or planning to do so in the near future. mGurujee application developed in India, allows users access to content in areas of engineering, management and medicine. It also has school syllabi of CBSE and ICSE boards as well as skill development, vocabulary and general knowledge tutorials

- **Learning Management Systems (LMS) and authoring Tools:** Educators are using LMS to manage content and lesson plans. There are authoring tools built in LMS as well as standalone authoring tools. Educators are using such authoring tools to customise the contents.

- **Game-or Simulation-based learning tools:** These applications integrate curriculum with augmented or virtual reality-based environments, helping students understand and learn in exciting ways. Students in vocational courses also rely on simulation-based applications to learn processes and concepts. Plumbers can learn to fix taps through simulations. DreamBox Learning's games for adaptive learning increased test scores of grade 2 students by 19% in just 2 weeks. MILLEE (Mobile and Immersive Learning for Literacy in Emerging Economies) applications enable children in the developing world to acquire language literacy in game like environments. This has been tried in India, with early replication underway in Kenya, China, etc.

- **Collaboration tools:** Networking platforms allow users to generate content and share and discuss it with a larger group. Mobile phones make this possible in real time.

- **Adaptive assessment services:** Educators can now access students' understanding using wireless assessments on handheld devices. These provide real-time updates on individual student progress, allowing educators to track class progress and tailor instruction for students requiring remedial support. Students all over the world take standard tests such as the SAT, GRE, TOFFEL etc. on their mobile devices and can benchmark their performance vis-à-vis other candidates.

- **Distance tutoring and homework support:** M-education has made possible supplementary education support outside the classroom. Online services make available tutors from around the world to students for learning and completing homework. "Dr. Math" tutorial service in South Africa uses volunteer students from local universities to tutor children on mathematics and other subjects. Students access Dr Math via any mobile phone-based instant messaging platform (such as MXit) and tutors provide help via a web environment on PCs. "BridgeIT" is implemented in Tanzania and Philippines to train primary school teachers and providing rich educational content to schools. The project has won several awards and accolades. The teacher downloads video contents on mathematics, science, etc., which are connected to TVs in their class rooms which displays the videos.

Technology enabled learning initiatives by the Ministry of Human Resource Development in India[13]

The National Mission on Education through Information and Communication Technology (NMEICT)

The mission is a centrally sponsored scheme to leverage the potential of ICT. It benefits the learners in Higher Education Institutions in teaching and learning process, in "anytime anywhere mode". This intervention is expected to enhance the Gross Enrolment Ratio (GER) in Higher Education. Government of India's education policy has three cardinal principles viz., access, equity and quality. These could be served well by (a) providing connectivity to all colleges and universities (b) providing low cost and affordable access-cum computing devices to students and teachers (c) providing high quality e-content free of cost to all learners in the country.

NMEICT seeks to bridge the digital divide viz. the gap in the skills to use computing devices for the purpose of teaching and learning among urban and rural teachers / learners in Higher Education. The mission focuses on (a) appropriate pedagogy for e-learning (b) creating virtual laboratories (c) on-line testing and certification (d) on-line availability of teachers to guide and mentor learners (e) utilisation of available Education Satellite (EduSAT) and Direct to Home (DTH) platforms.

Achievements of the projects sanctioned under NMEICT scheme are as follows:

Target	Achievement
Connectivity	
Extending computer infrastructure and connectivity to over 25000+ colleges and 2000 polytechnics in the country including each of the department of 419 universities/deemed universities and institutions of national importance as a part of its motto to provide connectivity up to last mile. Up to 400 nodes LAN on average to be provided under the Mission.	400 universities and nearly 19851 colleges in the country connected. BSNL has connected the universities using the IP based cloud of BSNL.
e-Content	
Creating high quality e-content for the target groups. Providing e-learning through online web and video courses in engineering, science and humanities streams.	Over 250 courses are complete and made available in National Programme on Technology Enhanced Learning phase-I. More than 990 courses in various disciplines in engineering and science are getting generated in phase-II.
Low Cost Access-cum-computing Devices (LCAD)	
Development of ultra-low cost computing devices to enable students to access education content. Even the best e-content would not have any impact unless it reaches the vast majority of learners with ease, as and when they demand it.	Aakash-1 launched in October 2011. The advanced version Aakash-2 (processor 3 times faster, memory twice the size, capacitive touch screen, high internal storage) launched in Nov 2012.
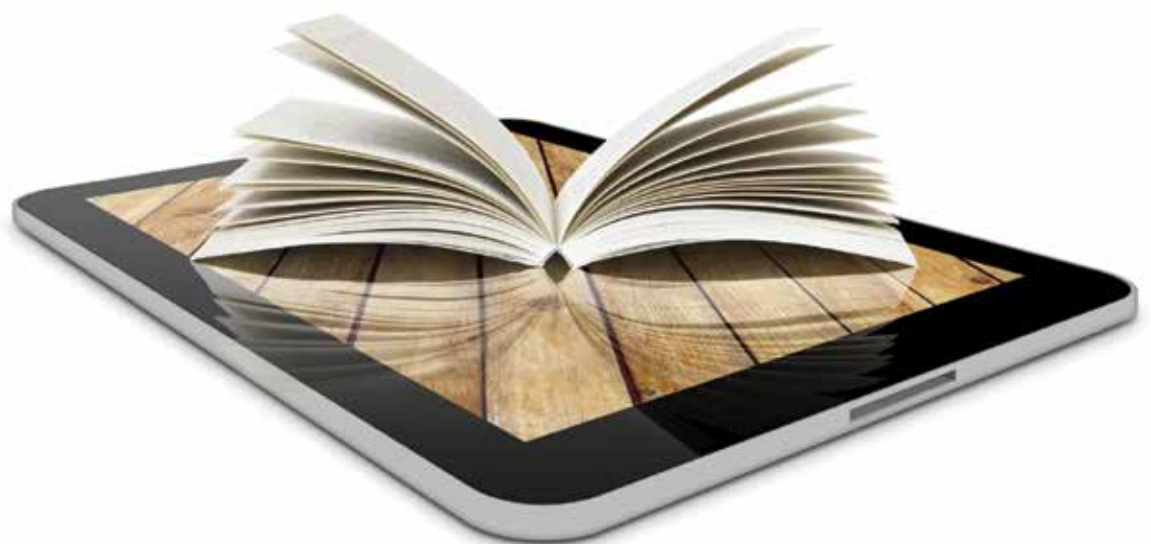
Collaboration tool "A-VIEW"

Amrita Vishwa Vidyapeetham has developed the collaboration tool "A-VIEW" for the National Teacher Empowerment Program under "Talk to a Teacher". A-VIEW was used to train 14,000 teachers in a workshop on Aakash 2 Tablets.

National Library and Information Services Infrastructure for Scholarly Content (N-LIST)

The programme provides access to more than 5000 e-journals and 80,000 e-books to all degree colleges except colleges imparting education in engineering, management, medical, nursing, pharmacy and dentistry. Log-in IDs and passwords have been issued to more than 432,375 individual users including faculty, students and researchers from the member colleges across the country. Registered users can access e-resources through proxy server installed at the INFLIBNET Centre.

Virtual Lab

Virtual Labs complement physical Labs and enable the user to perform experiments remotely over the web. Virtual Labs provide a complete learning management system where the students can avail various tools for learning, including web resources, video-lectures, animated demonstration and self-evaluation. Virtual Labs require one computer terminal with broadband Internet connectivity to perform the experiments remotely. Physical distances and the availability of resources will no longer be a constraint to learning. Over eighty Virtual Labs are currently ready for use at one common website www.vlab.co.in.

Education Satellite (EDUSAT) and Direct to Home platform

The power and reach of internet, intranet, EduSAT and Direct to Home (DTH) platforms will be harnessed to make knowledge available in the form of e-content, to learners across the country. The mission document envisages 1000 DTH channels & other video based programme including IPTV for e-learning. Department of Space (DOS) has agreed to provide two Ku band transponders of 36 MHz each on GSAT-8. It is planned to have 50-60 education channels.

Global Trend[14]

Massive Open Online Courses (MOOCS): It could be a game changer in the educational landscape.They are massive, with potentailly millions of users. And they are open: available to anyone, often for free or at minimal cost, much less than a traditional university course. They provide opportunity to those who would otherwise not have access to tertiary education, due to factors such as cost, distance, language, and the need to work.

Enterprise training and continuing education looks likely to be the fastest adopter of MOOCs, with significant growth in 2014 and 2015. Although the for-profit and not-for-profit tertiary education market is the largest, at $400 billion per year, the corporate skills development market is not small, at $130 billion annually.

Health Care catalysed by Telecom

The Indian healthcare industry, which comprises of hospitals, medical infrastructure, medical devices, clinical trials, outsourcing, telemedicine, health insurance and medical equipment, is expected to reach $160 billion by 2017, as per analysts.[15] The current size of the Indian telemedicine market is estimated to be around $7.5 million (as of March 2012).[16] The market is expected to grow at a CAGR of 20% over the next five years reaching around $18.7 million by 2017.

Health care system in India significantly lags behind its global peers. The country achieved some success in achieving the goals of National Rural Health Mission (NRHM), launched in April 2005. However, much more needs to be done in order to attain the Millennium Development Goals (MDGs). Some of the key challenges are as follows:

- Increase the public expenditure on healthcare from current level of around 1% to 2-3% of GDP[17] and about 15% of public budget (accepted norm for public spending on health).
- Improve access to safe drinking water, sanitation, waste disposal and controlling environmental pollution, as these have profound impact on health. Reduce the Infant Mortality Rate, Maternal Mortality Rate and fertility rate. Reduce disease burden of communicable and non-communicable diseases.
- Ensure availability of skilled and trained human resources at every level including sub-centers, primary & community health centers.
- The coming years will witness a shift in the way healthcare delivery is organized due to rapid development in tele-medicine. The challenge for policy makers is to integrate these developments into health care delivery systems.
- As per WHO's World Health Statistics 2012[18], India has the third highest out of pocket (OOP) expenditure on health in the south-east Asia region. As per WHO report, almost 60% of total health expenditure in India was paid by the common man from his own pocket in 2009. The Planning Commission too accepts that OOP to pay for healthcare costs is a growing problem in India.
- WHO benchmark is 2.5 doctors per 1000 population. India lags behind with 2.2 doctors per 1000 population.

India, the second most populous country in the world, needs a healthcare system that can meet the demands of over a billion people. Historically the commitment of Indian government after independence on healthcare has been guided by two policies (i) State responsibility for health care (ii) free medical care for all. Central and State governments have their own roles in the Indian healthcare system. The central government is responsible for framing health policies, disease control and regulatory issues. The state government is vested with the responsibility of healthcare delivery, financing the healthcare and training of healthcare personnel. Despite a large healthcare infrastructure, nearly 80% of outpatient healthcare and more than 50% of hospital care in India is provided by the private sector.

Planning Commission of India, in October 2010, constituted a High Level Expert Group (HLEG) on Universal Health Coverage (UHC), with the mandate of developing a framework for providing easily accessible and affordable health care to all Indians. It was recognised that the delivery of UHC will need financial protection as well as availability of adequate healthcare infrastructure, skilled health workforce and access to affordable drugs and technologies to ensure the entitled level and quality of care given to every citizen.[19] There is a clearly articulated governmental intent to increase the public financing of health to 2.5% of India's GDP, during the course of the 12th Five Year Plan.

Indian government schemes on healthcare
Government of India launched National Rural Health Mission (NRHM) in April 2005 with the objective of providing accessible, affordable and quality healthcare to the rural population. The Mission aims to achieve the goals of the National Health Policy and National Population Policy through improved access to Primary Health Services. It aimed to reduce the Infant Mortality rate to 28/1000 live births, reduce Maternal Mortality Ratio to 100/100000 live births by 2012, reduce Total Fertility Rate to 2.1 by 2012 and reduce the mortality due to communicable diseases. NRHM has emerged as a major financing and health sector reform strategy to strengthen State Health Systems.

Structure of health care delivery for the masses

The National Health Policy envisages a three-tier structure comprising the primary, secondary and tertiary health care facilities to bring health care services within the reach of the people. The primary tier is designed to have three types of health care institutions, namely, a Sub-Centre (SC) for a population of 3000-5000, a Primary Health Centre (PHC) for 20000 to 30000 people and a Community Health Centre (CHC) as referral centre for every four PHCs covering a population of 80,000 to 1.2 lakhs. The district hospitals were to function as the secondary tier for the rural health care, and as the primary tier for the urban population. The tertiary health care was to be provided by health care institutions in urban areas, which are well-equipped with sophisticated diagnostic and investigative facilities. In pursuance of this policy, a vast network of health care institutions has been created, both in rural and urban areas.

Increased availability and utilisation of health care services have resulted in overall improvement of the health status of Indian population. However, these achievements are uneven, with marked disparities across states and districts, and between urban and rural population.

Impact of telecom technology on healthcare delivery

Healthcare delivery is on the cusp of a shift in the way it is delivered and organised. Development in telecom and other related technologies are contributing to improved quality outcomes. These interrelated technological developments have also reduced the need for hospitalisation in several cases. Significant developments have taken place in the area of Telemedicine, which has the ability to make the services of a specialist needed at every Community Health Centre redundant. These technological developments need to be incorporated in the public health policy and a plan is required to have required finance and appropriate skills and competencies in place.

Global technology firm CISCO[20] undertook a study across ten countries in 2013. According to the study findings, respondents were more comfortable using technology to talk to their doctors than ever before. Tele-health is poised to take-off across the globe.

Phone, SMS, Email and video technologies stood out as the preferred mode of digital interactions. However, technology is not likely to replace doctor appointments completely. Most of the respondents preferred technology only for consultation, treatment reminders, information on side effects of the drugs, medication reminders.

India needs to use technology to get healthcare to its vast population. It also overcomes the chronic issue of shortage of medical practitioners in the country.

Telemedicine

It is the integration of telecommunications technology and medicine to create tele-medicine and tele-healthcare.[21] Healthcare professionals are now sharing information, holding consultations using satellite link / fiber optic network / mobile broadband across the ocean or cities or buildings. Videoconferencing equipment and robotic technology is helping in a big way to bring a physician clinics and medical facilities as close to a patient as the nearest computer monitor. There are two ways in which these technologies work (i) "store and forward" mode (ii) two way interactive television.

Store & forward mode: In "store and forward" mode digital images are transferred from one location to another. This type of technology is utilised for non-emergent situations, when there is time for a diagnosis or consultation to be made with the findings then sent back, usually within 24 to 48 hours. A healthcare professional takes a picture of a subject or an area of concern with a digital camera and the information stored on the digital camera is "forwarded" by one computer to another computer at a different location. The most common use of store and forward technology is with tele-radiology, where X-rays, CT scans, and MRIs can be sent from within the same facility, between two buildings in the same city, or from one location to another anywhere in the world. Radiologists are using tele-radiology facilities in order to eliminate an unnecessary and time-consuming trip back into a hospital or clinic. Tele-pathology is also another common use of this type of technology, with images of pathology slides sent from one location to another for diagnostic consultation.

Two-way, Interactive Television (IATV) mode: This technology is utilised when a face-to-face consultation is necessary. There is an originating site and a referral site. The patient, along with their healthcare provider (a doctor or a nurse practitioner) and a telemedicine coordinator (or a combination of the three), gather at the originating site. The specialist is at another site, called the referral site, which is usually at a large, metropolitan medical center. Videoconferencing equipment is placed at both locations allowing for a consultation to take place in "real-time". The cost of videoconferencing has decreased in last few years and desktop videoconferencing system can be operated easily by healthcare professionals. Almost all areas of medicine have been able to benefit from videoconferencing, including psychiatry, internal medicine, rehabilitation, cardiology, pediatrics, obstetrics, gynecology and neurology. Also, many different peripheral devices like otoscopes (which help doctors look inside the ear) and stethoscopes (which enable a doctor to listen to a person's heartbeat) can be attached to computers, aiding with an interactive examination.

It is not unusual to use store-and-forward, interactive, audio, and video still images in a variety of combinations and applications. Use of the Web to transfer clinical information and data is also becoming more prevalent, and wireless technology is being used to provide ambulances with mobile telemedicine services of all kinds.

M-health

M-health services make use of mobile devices to deliver healthcare solutions such as health alerts, updates and patient monitoring systems. M-health has revolutionised the healthcare sector by providing a method of interaction with the doctor, remotely on a continuous basis, improving care outcomes for patients and lowering the cost of care. The mobile network M2M operators provide the carrier facility and offer M-health solutions as one of the mobile value added service (MVAS).

M-health applications:
• *Home monitoring:* This involves patient self-testing using medical devices and remote transmission of the medical data to healthcare providers for disease management. Some of the chronic diseases

being monitored today are cardiac arrhythmia, hypertension, ischemic diseases, sleep apnea, diabetes, hyperlipidemia, asthma and Chronic Obstructive Pulmonary Disease (COPD). Home monitoring can become a treatment option. Applying information and communication technologies for home monitoring of chronic diseases can lead to decreased costs, more efficient care delivery and improved sustainability of the healthcare system.
• *Clinical monitoring:* Delivers more cost-effective healthcare management by safely reducing patients' hospital stays and visits. Patient sensors also act as extra eyes and ears for doctors, helping them to spot early warnings of medical deterioration and apply treatment earlier than physical diagnosis allow. These solutions dramatically improve the quality of life of patients, helping them to regain their mobility.
• *Telemedicine:* Doctors are scarce, especially in rural areas and their time is valuable. Telemedicine can allow these doctors to see more patients each day by eliminating unnecessary trips. Portable, wearable and even implantable sensors and tools can also watch vital signs and provide the data to healthcare providers in real-time.
• *Connected medical environments:* M-health solutions can monitor vital signs during exercise and transmit data to servers or the Internet in real time. Users can then quickly view and gain valuable insight on both their health and fitness regimes. This is possible with the help of connected weight scales, heart-rate monitors and other devices.
• *Clinical remote monitoring:* Monitor and track the status of patients with chronic conditions remotely. It improves patient care and outcomes through proactive monitoring. Clinical remote monitoring reduces home visits and the cost associated with it and keeps patients healthy with continuous monitoring.
• *Assisted living and clinical trials:* Ambient assisted living allows the elderly to remain independent in their own homes. Senior citizens are monitored to ensure their health, safety and well-being. Patient tracking systems offer doctors, relatives and caregivers a constant update on patient's whereabouts and health.
• *Asset management:* This enables tracking and managing mobile healthcare equipment. It improves productivity with visibility of asset availability.

India promoting and assisting Telemedicine globally

Apollo Telemedicine Networking Foundation (ATNF) was selected by the Ministry of External Affairs, Government of India, for the mega Pan-African e-Network project, to provide tele-consultation and tele-education to 53 countries of the African Union. Consultations with African countries are now well established. A state-of-the-art studio enables tele-lectures to be given to various countries in Africa.

Narayana Hrudayalaya used ISRO's satellite network to connect to 54 cities in Africa through its Pan-African Satellite Network. The satellite-based communication facility is used to treat patients and to educate healthcare professionals in Africa. Narayana Hrudayalaya is using Skype for video-conferencing, since it is relatively inexpensive and easily available tool. Regular tele-consultation with Skype is done with Dhaka, Bangladesh and several other locations. Telemedicine diagnosis is often the first point of contact with overseas patients who enter their International Outreach Programme. Narayana Hrudayalaya administers affordable healthcare and shares medical expertise and information with countries such as Malaysia and Mauritius.

All India Institute of Medical Science (AIIMS): The Telemedicine facility at AIIMS has following programs for SAARC and African countries:
• PAN – African e-network with 54 countries of the African Union.
• SAARC Telemedicine Project with 6 SAARC countries.

Global Trend[14]

eVisits: As eVisits are proven and adopted in the developed world, and as the necessary infrastructure is deployed in the developing world, they are likely to offer affordable primary medical and diagnostic care to very large populations that do not have access today. Although the initial benefit of eVisits may be saving billions of dollars, over time the greater good may come from saving tens of millions of lives.

The total addressable market for eVisits in developed countries is estimated to be about $50-60 billion. Penetration in Asia Pacific is limited.The Mashavu Networked Healthcare Solutions' pilot project has demonstrated that eVisits can be successfully deployed outside the developed world.

Telecom innovating Energy & Utilities

The Indian economy has experienced unprecedented economic growth over the last decade. This high economic growth has created severe demand and supply imbalances in energy requiring serious efforts by Government of India to augment energy supplies and to efficiently manage the existing resources. Energy is being recognised as a 'strategic commodity' by

"Communication technology will play a vital role in the Electrical grids of the future, enabling bi-directional flow of reliable and real time information between the utility and the consumer. While on the one hand this will improve the visibility and performance control of the Utility's network, on the other hand it also has the potential to empower the consumer through avant-garde concepts like Demand Response."

Sunil Mathur
Managing Director, Siemens India

developing as well as developed economies. Therefore, achieving energy security is of strategic importance, not only for country's economic growth but also towards meeting the Millennium Development Goals (MDGs).

India's per capita energy consumption[22] is significantly on the lower side vis-à-vis the developed world. India's energy consumption is about 900 kilowatt hours (kWh) per capita vis-à-vis 7,000 kWh per capita in Europe and 14,000 kWh in the US. There are huge losses in transmission and distribution systems. These losses are on account of both technical as well as commercial reasons. Transmission and distribution losses in grids of developed world are around 15%, but those by Indian state utilities are around 30% — equal to about 1.5% of the country's GDP.

The energy market is undergoing tremendous transformation. The world is becoming smart – smart cities, eMobility, smart grids and smart homes are calling for a new era of energy-saving technologies and systems. All parts of the electricity value chain are on their way to becoming "smart". This transformation has resulted in the evolution of communication service providers and telecom equipment manufacturers, as they leverage on their existing capabilities, to offer a slew of products and services to Utilities. These products and services can enhance the power delivery process, collect real-time data from the electrical grids and consumers and help Utilities operate in more efficient and cost effective manner. Linkage between information and communication technologies and electricity grids is being seen as one of the key growth sectors of the future, by communication service providers and telecom equipment manufacturers.

Smart energy products and services landscape
The concept behind safe, reliable and secure delivery of power and various products and services aimed at achieving this goal, are as follows:
Smart grid: The smart grid concept represents the modernisation of transmission and distribution grids, in order to support the energy needs of the 21st century. It is a step towards a safer, more efficient, and more resilient energy system. A smart grid is built by deploying robust end-to-end communication technologies. Sensing devices are placed on the grid, in consumer's home and businesses. These sensors send information about problems, grid performance statistics, status update etc. to applications that can read data and act upon it. The data processed and analysed by these utility applications, enable utility personnel in making better decisions regarding the delivery of electricity.

The smart grid empowers a consumer[23] to actively manage and monitor their energy usage, energy costs and energy sources. Communication service providers with their broadband offerings can enable homeowners to monitor and control their home appliances.

With the deployment of Information and Communication technology, real-time knowledge and information is shared by the smart grid, with the consumers. In this manner, the consumer is empowered to manage and control their energy usage, thereby, actively participating in energy demand management and cost control. Energy suppliers will be better equipped to reduce the frequency of power outages, as well as prepare for the future of renewable generation sources, distributed energy generation, and energy storage options.

Smart grid enables utilities to improve power delivery, power quality and operational efficiency while incorporating green energy and increasing customer relationship. Achieving these goals require a robust, secure, reliable and interoperable communications infrastructure. Though communications is not the core competency of utilities but they are central to meeting the challenges faced by the Utilities.

Smart meters: Smart meters track consumption in more detail than a conventional meter. A smart grid extends to businesses and households with smart meters, giving customers the information and incentives they need to alter consumption habits and economically shift their energy usage from peak to off-peak times. A smart meter supports two-way communication capability. While conventional meters track cumulative energy consumption, a smart meter has the capacity to store data on a daily, even hourly basis. The smart meter communicates this data to the utility for monitoring and billing purposes; and the utility can also make granular consumption information available to consumers via a web interface or email / text alerts. Through this technology, consumers are able to track the energy consumption on daily, weekly or monthly basis to make smarter, more energy efficient usage choices.

Smart homes: Smart homes will have several devices such as smart meters, smart appliances, personal energy management systems and home automation systems. These devices enable a consumer to manage their energy usage and costs. Consumers are provided

visibility into their energy usage on real time basis. Consumers can plan and organise their energy usage/ consumption based on the availability of peak/off peak rate and times. Both the utilities as well as the customers are better able to respond to changing conditions. Utilities are able to manage supply and demand in a smarter way.

Automated Load Balancing and Automated Switching & Protection Systems: The smart grid has created opportunities for improved power delivery encompassing Automated Load Balancing and Automated Switching & Protection Systems. At the heart of these systems lies a secure, reliable two-way communications network that enables real-time monitoring and control throughout transmission and distribution grids. Smart grid facilitates smart management of distribution. Communication technology has enabled putting Sensors[24] on capacitor banks, poles and transformers in a residential area and pulling data from the same. Distribution automation applications are helping utilities in analysing and interpreting this data and having an in-depth look at the grid. Substations are a critical part of the grid and give a detailed view of what's happening with insulators, lightning arrestors, capacitors, relays, etc. With the smart grid, utilities can have two-way communication with these devices on 24/7 basis.

Asset management: In the energy and utilities sector, companies write-off a significant amount of their assets every year on account of pilferage, theft and damage etc. The assets include copper, machinery and critical tools/parts. This has a direct bearing on company's operational efficiency and profitability. Mobile tracking and positioning technologies build on M2M platforms help utilities in reducing pilferage/theft, thereby, increasing uptime and enhancing utilisation of asset. Asset tracking is done in both indoor and outdoor environment with cell ID, GPS and radio beacon.

Optimising work force and managing mobility: In the energy and utilities sector, field maintenance workers, truck and tanker drivers, pipeline workers, etc. often operate in remote locations. Utilities need to be in contact with the mobile field workers to fulfil the need for basic maintenance, or respond to a dysfunctional power pole. Location-based technologies such a cell ID and GPS device-based on M2M platform, can pinpoint location and provide emergency support to field

workers in two-way communication mode. Utilities in the past have relied on land mobile radio (LMR) systems for communication. However, today latest mobile communication technologies based on GSM/CDMA based network are proving to be much more productive. Mobile workers with smartphones can access internal applications. To empower mobile workforce, utilities can provide connection to a virtual private network (VPN), with secure access to email, databases and applications they need to access.

Telecom companies and energy consumption

India's telecom sector has witnessed phenomenal growth in the last decade. The country has achieved an overall teledensity[4] of 73.5 (June 2013) vis-à-vis teledensity of 4 in 2001. However, this phenomenal growth has been at the cost of environment, because of Telecom sector's reliance on diesel for powering the Diesel Generating (DG) sets in towers. The industry operates over 400,000 towers[25], which need round the clock power supply. Subscriber base is expected to grow further and more towers would be required to ensure network coverage. Approximately 18% of the existing towers are off-grid, in remote rural areas. The rest of the towers have erratic power supply. Diesel consumption of the Indian telecom industry[26] is around 3 billion litres a year, which is more than the diesel consumption of Indian Railways. The DG sets running at tower sites are responsible[26] for over 6 million tons of CO_2 emissions in the environment. It was projected by Greenpeace report that by 2012, the sector's electricity requirement would be around 26 billion units of electricity.

Adopting greener means for power consumption in passive telecom infrastructure

To reduce the CO_2 emission and the operational expenses, telecom and tower companies are adopting a number of strategies as follows:

1. *Reducing power consumption:* The telecom and tower companies have undertaken a number of steps on the demand management side. Passive infrastructure sharing (towers, shelters, DG set, batteries), replacement of old base transceiver stations (BTS) with next generation BTS consuming less power, usage of outdoor BTS with ambient air circulation easing heat dissipation, innovation in shelter design with free cooling units and green shelter, usage of intelligent transceivers (TRXs) and operating air conditioners using stored energy in the

batteries to reduce diesel consumption - are some of the initiatives undertaken by telecom and tower companies to reduce power consumption.

2. *Improving efficiency of backup power:* Using DC Diesel Generator set and rightsizing DG sets are some of the initiatives taken by companies on the supply management side. DG sets incur losses while converting to DC voltage required for BTS. Using DC diesel sets vis-à-vis the normal AC DG set reduces the losses. A DC DG set costs more than the AC DG set, but the higher capital expenditure can be offset by saving operational expenses. Using right sized DG set reduces diesel consumption. Making use of fuel additives/catalyst improves fuel efficiency by breaking long chain hydrocarbons into smaller molecules, which burn more efficiently. Increased consumption of CNG and LPG also result in lowering the CO_2 emissions.

3. *Adopting renewal energy:* Renewable energy solutions such as solar photovoltaic, wind power, fuel cell and Biofuels have been deployed by telecom and tower companies. Solar DG hybrid solution is being used quite extensively to reduce the dependence on DG power back-up. Wind mill DG hybrid solution is also being used to reduce the DG set running. Biofuels are being adopted in place of fossil fuels as they are less polluting and location independent. The quest of the telecom industry to have economical and scalable energy management solutions, has resulted in the creation of an entity in the value chain, called the Renewable Energy Service Company (RESCO). The RESCOs are expected to design, deploy and manage optimal renewable energy solutions that will help the telecom industry to overcome the energy management challenge. These companies set-up plants based on renewable energy solutions for telecom and tower companies and sell back-up power under the Power Purchase Agreement (PPA). RESCOs offer competitive PPA rate and supply surplus power to the nearby communities.

Initiatives taken by the telecom industry[27]

Bharti Infratel's Green Towers P7 initiative: It is comprehensive energy efficiency and alternate energy program covering seven high impact initiatives, some of them are as follows:

• Alternate energy sources like solar etc. deployed at around 1050 sites, resulting in saving of ~6.9 million liters of diesel.

- Energy efficiency measures like Integrated Power Management System (IPMS) and variable speed DC generators (DCDG) deployed across 900 sites resulting in reduced diesel consumption by 1.2 million liters.
- Demand side management like Free Cooling Units (FCU) instead of air conditioners etc. deployed across ~3400 sites reducing the electrical load requirement, saving consumption of almost 4.1 million liters of diesel.

Vodafone's green initiative: A comprehensive program encompassing solutions for both active as well as passive infrastructure:
- Active Equipment Solutions made improvements to their base stations, which include shutting down associated cabinets and extra transmitters during low traffic so as to reduce energy consumption, resulting in saving nearly 4 million kW of electricity and reduction in CO_2 emission by 3,240,000 kg per annum.
- Passive Infrastructure Solutions:
  - Free Cooling Boxes (FCB) – AC units shuts off when outside air temperature is lower than 26° C. This solution has been implemented at 1500 sites, resulting in reduction of CO_2 footprint by 5.8 million kg CO_2 per annum.
  - Solar Powered Sites – Implemented at off grid sites, resulting in reduction in CO_2 footprint by 2.8 million kg CO_2 per annum.
  - Hybrid Solutions – Implemented at 2200 sites, they have led to a reduction in diesel consumption by 2.6 million liters annually.

Uninor Energy Saving OPEX model[28]: Uninor plans to implement 8000 Free Cooling Units, 10000 fuel catalysts and 200 solar powered base transceiver stations (BTS) across India.

Indus Tower green initiative[29]: Indus has created green sites across 15 telecom circles.
- 20000 green sites comprising of 20% of Indus portfolio of towers are green viz. no diesel consumption.
- 15000 free cooling units have been installed, resulting in reduction of energy consumption.
- 2500 sites have been facilitated with smart battery charging solutions for battery charging, resulting in saving of energy.

Telecom equipment vendors initiative: Vendors such as Ericsson, Huawei and Alcatel Lucent are also developing green products:
- Ericsson has developed the Ericsson tower tube, which uses natural convection cooling, to reduce feeder loss, resulting in a reduction of up to 40% in power consumption.
- Huawei has developed single RAN solution based on software-defined radio (SDR) system to truly integrate multiple networks.
- Alcatel-Lucent Bell Labs, in collaboration with service providers and other leading research organisations around the world, is launching the Green Touch™ Initiative.[30] It is a global consortium focused on making communications networks 1000 times more energy efficient than they are today.

Global Trend

Digital Energy: It is the convergence of the energy, telecoms and information technology industries. Intelligent systems that monitor and control transmission and distribution grids are improving reliability, security and efficiency of supply. Integration of machine-to-machine technology on both demand and supply side can add high value. Eenrgy Management systems are now being augmented by smart intelligent devices.

Role of telecom in inclusive financial growth

India's banking sector is currently valued at ₹81 trillion[31]. Almost 41%[32] of India's households are unbanked and approximately 67%[33] of all retail transactions are still being conducted in cash. Indian banks face several challenges, such as the need for increased penetration of banking, meeting the customer expectations due to emerging technologies and competition, risk management, transparency and disclosure norms, employee and customer retention to name a few.

A comparison of India with similar developing economies such as China and Brazil shows the situation of banking infrastructure:

Table 1: Indicators of Financial Inclusion 2011[34]

	Number of bank branches	Number of ATMs
	per 0.1 million	
India	10.64	8.9
China	23.81	49.56
Brazil	46.15	119.63

Source: Financial Access Survey, IMF

India's financial sector is highly diversified. It comprises of commercial banks, insurance companies, non-banking financial companies, mutual funds, etc. India's financial sector is dominated by banks with commercial banks accounting for over 60% of the total assets of the financial system followed by the Insurance sector. Regional rural banks and cooperative banks target under-serviced rural and urban population. India could endure the disruptions in the global financial system due to a robust regulatory framework, limited openness and timely policy actions especially to manage liquidity. The global financial crisis provided a renewed impetus to the second generation financial sector reforms in India.

Until 1990, the banking service delivery model was that of 'distributed banking'. During 1995-97, the telecom technology transformed the delivery model and structure into a "networked" one. Under this delivery model, branches located in a region were interconnected. The centralised operations appeared in the year 2000.

India has a highest number of households (approximately 145 million) who are excluded from banking. They rely on informal channels, shadow banking system and get exploited. In the past, people have been defrauded and have lost hard-earned money by investing in Chit Fund and other Ponzi Schemes. The fact that people rely on such unreliable schemes for their saving/financing needs, is a reflection on the failure of the financial system, to reach out to such groups. The need of the hour is to provide this population access to a formal banking system. Hence, the financial sector and system should aspire towards financial inclusion and financial literacy of the unbanked population in India. The Government as well as the Reserve Bank of India (RBI) is placing special emphasis on driving financial inclusion across the country. In the absence of quality data for authenticating this segment, financial institutions are unable to provide banking services to this segment. However, the 'Aadhar' initiative is going to be a game changer. Under the "Aadhar" initiative,

"Without mobiles, financial inclusion would mean viability exclusion for Banks. Mobile brings in personalisation and instant two-way communication needed to educate and cultivate new customers."

Ravindra Deshmukh
Managing Director, Upass

there will be a single database capturing the attributes of every citizen in the country. RBI has directed the banks to accept the 'Aadhar' card as an identity for opening of bank accounts. Remittance solutions, no frills banking account and micro insurance products are in various stages of rollout for this segment. In addition to this, Indian Financial sector also has to deal with the challenge of rapid innovation in technology, leading to newer ways of delivering banking services to customers.

Leveraging Technology for Banking

In last fifteen years, technology has brought a paradigm shift in the functioning of the banks and insurance companies. Information and Communication Technology (ICT) has not only helped in improving the operational efficiency but has also resulted in enhanced customer satisfaction. Most of the banks have invested in core banking systems for improving the customer facing processes. A number of banks are focusing on digital banking and self-service channels to reduce the cost of operations. ATM channel, internet banking and mobile banking are a big success in India. The transformation of consumer banking is driven by the convergence of banking and telecommunications players (including the Internet service providers) and Web portals.

Serving the unbanked population in remote areas is considered unprofitable/unviable by conventional banking system. Information and Communication Technology (ICT) can act as an enabler to make financial inclusion a viable business. Technology has the potential of being a force multiplier in achieving financial inclusion. It can enable cost effective delivery models, hitherto deemed unprofitable by traditional banking operations.

Low cost ATMs, use of internet, point-of-sale terminals and mobile banking are some of the technologies, which have become very popular, in the last one decade. Internet banking has made a profound influence on the distribution of financial services. Banking via mobile phones appeals to both urban as well as rural customers.

Technology has led to the emergence of cost-effective alternatives to the bank branch. Each transaction at branch costs about ₹50 whereas the cost of each transaction at ATM is approximately ₹15. Internet banking (₹4 per transaction) and mobile banking (₹1 – 1.5 per transaction), provided industry the new operating paradigm it was looking for. The cost advantage offered by these emerging delivery models led banks to alter their transaction and channel mix, to achieve cost reduction and to drive business growth. As a result, in the last 10 years, the expensive bank branch network has stagnated, as ATMs and other channels have seen double digit growth. Percentage of ICT-based accounts through BCs to total basic bank accounts has increased from 25% in March 2010 to 45% in March 2013.[35]

One of the objective of National Telecom Policy 2012 is to achieve rural teledensity of 70 by the year 2017 and 100 by the year 2020.[36] Mobile telephony has strengthened its position as a ubiquitous connectivity tool and is likely to lead the way. For example, in the month of November 2013, 7.16 million transactions amounting to ₹19.57 billion were processed as compared to 4.72 million transactions amounting to ₹5.39 billion processed in November 2012[37] - an increase of about 52% in volume and approximately 263% in value terms. For the affluent urban customers, mobile banking offers the convenience and ease of transacting. For the unbanked rural customer segments, mobile-device based banking offers low-cost access and reach – substituting the need for a physical bank presence. Technology innovation along with conducive regulatory framework is now facilitating the reach of financial services among the financially excluded.

There is increasing realisation[38] that reliance on technology-enabled channels alone, will not help in achieving the goal of creating an inclusive financial system. Wherever feasible and viable, banks may consider opening more brick and mortar outlets as delivery points, as well as control mechanism for Banking Correspondents (BC). Banks also need to evaluate the choices made available by the technology, in the context of providing last mile connectivity which provides "near branch" experience. The other methods of interaction such as direct channels and alternative outlets such as Banking Correspondents (BC) are important to gain the trust and acceptability of the financially excluded segment of the population.

Technology automates the processes leading to improvement in productivity, which in turn reduces the cost. Technology drives penetration, helps in connecting with customers, through a preferred channel at their convenience. The connectivity options provided by technology enable banks to serve customers in the far-flung areas. Financial services firms need to ensure that both productivity and penetration initiatives are managed hand-in-hand and improvements in both are achieved in parallel. This in turn, will help banks in achieving the ambitious target set by RBI for financial inclusion while providing superior returns to their shareholders.

New initiatives such as AADHAR, Swabhimaan, Mobile Payment Forum of India (MPFI), Micro-insurance etc., facilitated by the Government, the RBI and other regulators (IRDA) have brought new stakeholders in the financial services ecosystem. The ecosystem is now seeing the evolution of new partnership models between banks, insurers, pension players, other financial services firms, technology players, telecom service providers, banking correspondents, etc. These new partnership models are leading to the development of new cost-effective operating models, having the potential and promise to expedite the journey towards the goal of financial inclusion for all.

M-Banking & M-Payments

Mobile Banking is the provision of banking services with the help of mobile communication devices. The scope of services includes performing balance checks, account transactions, payments, etc. Mobile payment is a type of transaction in which the mobile handset plays a key role in initiation, authorisation and/or realisation of the payment. Mobile payments are a substitute to cash for Point of Sale payments.

Almost 41% of India's households[39] are unbanked and approximately 67% of all retail transactions are still being conducted in cash. The country has[4] a mobile phone subscriber base of 873 million (from 165 million in 2007) and mobile teledensity of 71.08 as of June 2013. Mobile phones could act as a perfect platform to offer financial inclusion in terms of banking or payment services. Mobile phone has the advantage of reach and cost vis-à-vis other banking delivery channels. Mobile

phones are already being used by ~17 million Indians[39] for banking purpose and its usage for banking and payment transactions is on the rise. Although limited banking services are available currently on mobile phones, this channel has tremendous potential.

M-Banking & M-Payment models in Indian market

Two types of mobile banking models are prevalent:
Bank-led mobile banking model: Reserve Bank of India has opted for a bank-led model and a technology neutral approach for India. Use of mobile for banking, cannot become a viable proposition on a standalone basis, if the purpose is to achieve meaningful financial inclusion. To make it viable and attract volumes, it has to be provided as a package along with other products and services such as emergency and entrepreneurial credit, saving facilities, insurance, remittances, etc. This is where a mainstream regulated entity like a bank fits in. Banks partner with mobile service providers (MSPs) and other entities, to achieve the national goal of inclusive growth.
Mobile operators-led mobile banking model: Reserve Bank of India[40] has not opted for model led by telecom operators and other mobile payment firms since it does not complement the government's financial inclusion agenda and is limited in its scope when compared with the bank-led model. Mobile operator-led mobile payment systems can only provide a remittance facility. They cannot provide other benefits under financial inclusion such as overdrafts, credit and micro-insurance. Mobile operators are unable to address the Know Your Customer concern to the same degree as the banks. Mobile operators cannot be subjected to the same degree of regulatory oversight.

However, Reserve Bank of India has recognised the important role that could be played by the MSPs in the payment space. MSP's have a footprint across the length and breadth of the country through their vast agent network. Banks do not have physical presence everywhere. Therefore, it has enabled the MSPs to be appointed by banks as their business correspondents, to foster a healthy partnership. With this partnership between the banks and MSP, the expertise of banks and the reach of the MSPs could be gainfully utilised to achieve the goal of financial inclusion.

RBI has authorised 17 non-banks to issue prepaid payment instruments, including mobile-wallets. These include a mobile service provider and a mobile phone company. Fund transfers from these instruments have been permitted in a limited way to enable money transfers by the domestic migrant population to their families.

RBI approved a unique initiative, the Inter Bank Mobile Payment System (IMPS) to enhance the efficiency of the mobile banking system. IMPS is operated by the National Payments Corporation of India (NPCI). IMPS system provides a centralised interoperable infrastructure and enables money transfers between customer accounts in different banks through mobile phones in real time. The service is easy to adopt for the banks, as it rides on the existing National Financial Switch (NFS) Interbank ATM transaction switching infrastructure and message format.

TRAI has come out with the 'Mobile Banking (Quality of Service) Regulations 2012' specifying the standards for MSP's while facilitating mobile banking. This regulation will help in wide spread adoption of the mobile banking services in the country. The MSP's should strive towards meeting these service standards to the banks to enable the customers to enjoy customer friendly banking services.

Mobile wallet, the big idea that is catching up fast
The mobile wallet allows customers to transact on the move. Unlike mobile banking, a mobile wallet is not confined to one particular account holder and a bank account is not required to use mobile wallet service. Cash has to be loaded into prepaid mobile wallet by approaching a wallet service provider. Once the cash is loaded, customers can send remittances to any bank account and can transfer funds to other wallets. In a semi-closed wallet, apart from a bank, money transfer to another mobile wallet is allowed. However, withdrawing money is not allowed. The customer is not required to fulfill the KYC norms. There are open prepaid mobile wallets services where maximum account balance of ₹50,000 is allowed. The bank is accountable for customer KYC. Cash withdrawal is allowed at enrolled agent outlets, who act as business correspondents of the partner bank.

State Bank of India (SBI) has launched Mobicash Easy, a prepaid mobile wallet service. SBI's Mobicash Easy wallet provides customers with services such as cash deposit, transfer from wallet to wallet, transfer from wallet to SBI bank account, transfer from wallet to another bank account, mobile/utility payments and DTH/prepaid mobile recharge. Mobicash Easy users can deposit money into the wallet, request mini statements and a reversal of transaction. As per RBI's regulation, users cannot withdraw cash from SBI's Mobicash Easy prepaid wallet. It is not mandatory to hold an SBI account to use SBI Mobicash Easy. The service does not require users to submit KYC documents. SBI Mobicash Easy does have a limit to transactions.

Airtel offers a semi-closed mobile wallet service which allows Airtel customers to pay utility bills, recharge their phones, shop at merchant outlets and make online transactions, using their mobile phones. It also allows users to make instant money transfers between one Airtel money wallet to another and to bank accounts across the country.

In addition to prepaid mobile wallet service, there is an account-based model, requiring a bank account.   With the help of mobile based application, pre-installed on the SIM card, the bank account can be operated from the mobile hand set. Under this model all the internet banking services are available. Payment of utility bills, bus/train/flight tickets booking, recharging prepaid mobile or DTH connection can also be done.

Tapping USSD to expand access to mobile banking services[41]
The Unstructured Supplementary Service Data (USSD) platform offers a common gateway to customers of all banks to easily access and use mobile banking services. The major advantage of USSD is that the IMPS could become accessible even through low-end handsets. However, on account of concerns of MSPs on revenue sharing, IPMS system of NPCI has not taken off in a big way.

If the common USSD platform is offered by all MSPs, the same is expected to lead to an exponential growth of transactions in the IMPS. The IMPS platform for the merchant transactions (person-to business) transaction has now been enabled. Along with it, person-to-person (P2P) remittances can now be made to beneficiaries based on their bank account number or Aadhaar number, which is mapped to the mobile number of the beneficiary. The requirement of Mobile Money Identifier (MMID) at the beneficiary end, therefore, becomes optional. Further, the non-bank entities like the Pre-Paid Instruments (PPI) issuers have been permitted to join the IMPS network through a sponsor bank for measures should lead to an increase in transactions and should significantly contribute to the revenue streams of the MSPs also.

Issues around wide spread acceptance of M-banking and M-Payment
Ease of use, safety, security, accessibility and affordability are some of the issues, to attract the customers and retain them to M-Banking and M-Payment services on long term basis. The stakeholders in M-Banking and M-Payment ecosystem such as Banks, Merchants, MSP's, and Banking Correspondents etc. believe that requirements of ease of use, safety, security, accessibility and affordability are being met. Despite this, uptake of M-Banking and M-Payment service is nowhere near its full potential. Lack of easy to use applications and easy to use services, is not providing the customer the same level of comfort that is available with other payment mechanism. Customers have concerns on security viz. what will happen in case a transaction fails, who should be approached for their grievance. Cash transaction is considered safe vis-à-vis digital money transaction by a majority of population. Only certain types of transactions are permissible in M-Banking and M-Payment, this may be perceived as lack of flexibility by potential customers. This could act as a bottleneck in widespread adoption of mobile money.

Financial inclusion attempts in other countries[39]

Kenya: M-PESA, launched in Kenya[42] in 2007 is a big success story. M-PESA users can use their mobile phones to transfer money to another mobile phone user. The system provides a safe, secure and fast money transfer facility at a very low cost. There has been wide spread acceptance of the M-PESA service in Kenya, due to the large demand for financial services, which has not been met adequately by the Kenyan banking sector. In India, on the other hand, the reach of the banking sector has been wider and the focus has been on the bank-led model for financial inclusion. Further, mobile-led banking can take care of only remittance products as against a bouquet of products, viz. deposit product and overdraft/emergency credit product, which are being provided as part of the financial inclusion policy in India. However in India, efforts are being made to leverage the reach of mobile phones by allowing banks to appoint Business Correspondents (BCs) for financial inclusion.

South Africa: Mzansi accounts are no frills bank accounts and a certain minimum number of transactions are free. Although about 18-20% of the population has a Mzansi account, only about 50% of those are active. India too has a similar scenario and similar challenge, only 10% of the people, who signed up for the account, are active.

Brazil: Banking correspondent model has been very successful in Brazil. India has several socio-political and economic similarities to Brazil. India can also examine the feasibility of Banking Correspondent model.

Sri Lanka: Palm top banking introduced by Seylan Bank is another version of Banking Correspondent / mobile branches. Seylan Bank has used technology to introduce mobile teller services to enable customers to conduct basic transactions. Motorcycle-bound Business Development Officers (BDOs) of Seylan Bank, armed with a personal digital assistant, mini-printer and cash, bring banking services to the heart of the Sri Lankan jungle. BDOs can open accounts, take deposits of up to Sri Lankan Rupees (LKR) 250,000 ($2,265), dispense cash of up to LKR 5000 and provide services such as insurance and consumer finance.

Global Trend

Wearable banking: Banking applications on or that utilize things we wear, like smart glass, fitness bands and smartwatches. Widening cellular connectivity and the move towards online banking may signal significant opportunities for wearables in the middle and long-term. Big banks are now coming to small screens. Users can use the app+hardware interface to look up account details, pay bills by taking pictures of them, transfer funds between accounts, pay for purchases using voice commands or by snapping images of QR codes. The app also helps users find the nearest ATM using the built-in GPS system.

Telecom setting the trends

Telecom sector in India is undoubtedly one of the most lucrative markets, reliant on volumes, rather than margins. Although voice market is saturated, there is still ample space for growth in the sector. With the growing interest in Value Added Services, the Government as well as Telecom companies are focusing on increasing connectivity across India to provide e-learning, tele-medicine, m-banking and e-governance models. Henceforth, operators are exploring emerging digital trends such as big data, mobility, cloud computing and cyber security. By adopting these trends, operators can enhance their revenue streams and differentiate their offerings in the highly competitive telecom market. By leveraging digital technologies, organisation can not only increase its reach but also enhance customer satisfaction. Business processes are transformed hence increasing productivity and revenues. It is observed globally that digital transformation leads to approximately 50% increase in return on investment. These trends are discussed below:

Big Data
The term big data, which represents exponentially growing datasets and availability of both structured and unstructured data, is catching up rapidly worldwide. It is massive in nature with sizes beyond the ability of conventional database tools to store, manage, and analyse it. On one side, this is a huge opportunity for the industry globally, and on the other side, its processing becomes difficult through traditional database and software techniques. Big data has a significant impact on companies' competitive differentiation and ability to avert risk by fetching new levels of business value through smart decision making. It helps in achieving efficiency, quality, and personalised products and services, enhancing the customer satisfaction and experience. It serves several industries such as manufacturing, retail, financial services, telecom, and healthcare.

Market overview
The growth of big data market is thriving both in India and worldwide. By 2015, big data is likely to grow into a $25 billion industry, growing at a CAGR of 45%.[43] The Indian big data industry is expected to rise from $200 million in 2012 to $1 billion in 2015 at a CAGR of 83%.[44]

As per one survey, biggest challenge lies in understanding of the big data for almost 15% of the organisations.[45] According to another Survey, awareness about big data among the Indian enterprises is close to 70%.[46]

There are various global players in providing the big data solutions. SAP, IBM, Guavas, Opera solutions and CSC are the major key players. Infosys, Wipro, TCS and HCL Technologies are amongst the key Indian players. Solutions range from analytics platform, cloud platform, visualisation, to business intelligence.

Big data and Telecom

Factors like development in technology, proliferation of mobile devices and the necessity of the consumers to stay connected round the clock, have led to unprecedented hike in scale, speed and scope of services by telecom companies across the globe. Today, telecom operators face pressure in reducing costs, maximising average revenue per user (ARPU) and enhancing customer experience. Big data helps telecom companies in exploiting the vast data available to reduce customer churn, decrease operating costs and increase revenues.

- Customer agitation: Find the prospect market, based on the customers having the higher risk of leaving, who can be retained and offer customised services to attract them.
- Customer experience: Get detailed customer behavioral insights, create actionable plans, offer customised services and explore new revenue opportunities through up-sell/cross-sell.
- Network monitoring and maintenance: Get real-time picture of network, analyse performance, detect and resolve issues and manage other stakeholders involved.

Big data creating business value

Big data serves as a gold mine, i.e. gigantic repository of business mysteries, opportunities and potential success. Through big data, positioning of all the information, both legacy as well as unstructured data, can be done effectively making data more transparent and usable on a regular basis. It guides organisations in getting insights through richer and broader data sets, thereby, creating more narrow segmentation that helps companies to apply more focused marketing campaigns and sales techniques and realise new products and services to offer. Therefore, helping organisations to achieve competitive advantage and open up new business opportunities. Proper planning and application of technologies and tools such as data warehousing, analytics and predictive modeling can subsequently create business value and drive excellence by discovering patterns, connections and relationships.

Analytics

Analytics is using data to make smarter decisions that support effective management, drive business transformation and improve performance. Successful use of analytics is rooted in real business problems such customer, finance, workforce, regulatory, operations and supply-chain. Several trends are driving the adoption of analytics like data volumes, regulations, profitable growth, hidden insights to name a few. Embedding analytics starts with the focused development and education of an ecosystem.

Analytics creating business value

Big data and the analytics that can put it to work are now accessible to small and medium enterprises, not just market giants. Analytics has a lot of potential and it can be significant as measured in dollars. There are real and significant benefits when analytical capabilities are applied to problems in specific domains of telecom, technology, media:

• Tailor dynamic content
• Find new revenue streams
• Complex rights and royalties
• Maintain customer satisfaction and loyalty
• Understand retail and direct to consumer market
• Online behaviour encourages greater customer care
• Maximise advertising revenues in a multi-device world
• Data connectivity is increasingly important to consumers - at the right price

Mobility

Faster technological growth in wireless connectivity and mobile devices marked the foundation of the mobility revolution for the telecom sector. As convergence is boosting, there will be new demand for all kinds of connected devices.

Market overview

Mobility is quickly becoming one of the key frontlines for business innovation. Telecommunications and mobility technologies will play an important role in the success of geographically distributed companies in the coming years. Enterprises will remain focused at enablement and development of mobility solutions[47] i.e. there would be rise in smartphone, tablet, and the app

environment within the enterprises to stay connected and hence increase the overall efficiency. In India enterprise mobility is still in its initial stage[48], but the growing comfort level of Bring Your Own Device (BYOD) and its associated mobile security solutions will allow the trend to become more familiar in enterprises. Enterprise mobility market in India is expected to increase almost five folds, touching $1 billion by mid-2015, up from $244 million in 2011.[49]

Mobility creating business value

With the help of enterprise mobility solutions there is a possibility of bringing better operational and process efficiencies, expanding new business opportunities and providing better customer service through a connected and active workforce. With the proliferation of connected devices, following trends are adding business value:

• *Mobile payment systems:* The growth of mobile applications and Near-Field Communications (NFC) technology continues to cut the market share from plastic payment methods. In countries like India where few people have bank accounts while many more have a mobile connection, mobile payment systems could do wonders.

• *Mobile device management:* In the current enterprise mobility world, Mobile device management is becoming a necessity to manage various issues, especially the trend towards BYOD in which employees are allowed to select their mobile/wireless devices to use for work purposes. MDM provides a management and administrative layer to the enterprise which creates a secure environment for corporate data and assets. There are approximately 180 million enterprise BYOD devices globally, which is expected to increase 390 million by 2015.[50]

• *Mobile advertising:* As customers spend more time on their mobile devices, there is a huge opportunity for mobile advertising.

• *Mobile video:* Mobile videos are quickly becoming a mass user trend.[51] Mobile video gained 15 million viewers from 2010 to 2012, and it is predicted that video will account for 66% of mobile traffic in 2017.[52]

• *Mobile cloud computing:* New business models are evolving where mobile is becoming a main feature

in cloud computing. The mobile cloud ecosystem is swiftly developing with new and secure products available on the market. Cloud players and enterprises could profit from the opportunities offered by this growing market.

Cloud Computing

Cloud Computing provides hosted services over Internet. It is the sharing of computing resources as a service wherever and whenever required - from infrastructure, applications, business processes to personal collaboration. A cloud service is fully or partly managed by the provider and sold on demand, i.e. pay-per-use model.

Market overview

The worldwide cloud computing market will grow at a 36% CAGR, reaching a market size of $19.5 billion by 2016.[53] With substantial advancements in virtualisation, distributed computing, and high-speed Internet access, cloud computing technology has enhanced significantly in India. As per the industry forecasts, the cloud market size is expected to grow up to $4.5 billion by the year 2015 in India.[54]

Cloud services are a booming market segment having tremendous potential. Software as a Service (SaaS) being the broad market is considered as the "third wave" in software adoption.[55] Salesforce and NetSuite are well known SaaS providers. Platform as a Service (PaaS) is extension to SaaS. PaaS providers may use APIs, website portals or gateway software installed on the customer's computer. Force.com and GoogleApps are examples of PaaS. According to Gartner, Infrastructure as a Service (IaaS) is the fastest growing market segment. IaaS is typically based on pay-per-use model like Amazon Web Services.

Cloud computing is a daunting task. Enterprises are still facing roadblocks in implementing cloud services. Security is the biggest pain point in its adoption followed by migration and integration of legacy and on-premise systems with cloud applications.[56]

Cloud computing creating business value

Cloud computing is not only the next step of internet transformation but it also contributes towards building business value. One of its benefits is reducing IT costs as one need not purchase the expensive systems, thereby, reducing the CAPEX as well as the OPEX. It provides scalability and flexibility to the business processes. Automated processes bring about collaborative efficiency and business continuity by minimising any downtime and loss of productivity.

With innovation crafting the way of internet technology, following trends are adding business value:
• To meet the ongoing demands enterprises are opting for a combination of private and public cloud services, thus giving rise to hybrid cloud. It will offer affordable infrastructure to small and medium businesses (SMBs) and custom solutions for big data analytics.
• With cloud computing, data processing would happen in real time. Therefore, industrial Internet will touch the real-time processes and practices with smart data, thereby, improving the performance through precise decision-making.
• Security of information being the biggest challenge for IT, there would be a development in the security measures and policies.
• Deploying web based cloud applications will make the content accessible to anybody anytime anywhere.
• The BYOD trend has already gained momentum and is going to further push the enterprises to adopt cloud computing for mobile device and personal cloud services management.

Cyber Security

Security is the critical element of concern with emerging Internet and telecom value added services. Today information security has emerged as a cause of concern for all sectors, right from the telecom, banking, utilities, healthcare, and transportation to the government and emergency services. India has seen a steep rise in the number of cyber-attacks on its wired as well as wireless networks in the last two to three years. According to industry reports, cyber-crime is estimated to be around $218 million in India[57] and the highest rate of cyber-

crimes is found in areas with uninterrupted internet connectivity in India. The increasing volume of cyber threats like phishing scams, data theft and other online vulnerabilities has made it mandatory to secure systems and information. Cyber security deals with the threats to the cyber network with the malicious intrusions using vicious codes including viruses, worms, spyware, and malware with an intention to cause harm.

Growing cyber-attacks and cyber-crimes on the networks hamper the businesses. Given below are the major security challenges faced today in the industry. Even telecommunications networks are gradually besieged by the attackers or hackers to disrupt, deny or intercept communications. Large client base makes telecom companies prone to hackers and malicious attacks like website mutilations, interruptions of service, and credit card and identity theft, hence posing threat to the entire national security. The government has identified a list of critical communication infrastructure to implement a multi-prolonged security strategy against these cyber-attacks.

Market overview
Network Security consists of various layers of components using hardware and software, thus making provision in an underlying computer network infrastructure, in order to prevent and protect the network and the network-accessible resources from unauthorised access. It helps from the prevailing cyber-

attacks. Indian companies are spending more than ₹250 million on information security. This marks a 100% increase in the firms spend in cyber security as compared to 2012.[58] Some of the major players in the network security sector include Cisco, HCL Comnet, Juniper Networks, Elitecore Technologies, Fortinet, Wipro, Sify and Datacraft amongst others. Following are some of the available solutions:
• Anti-virus and anti-spyware.
• Firewall and secured Gateways - Monitor and block unauthorised access to network
• Intrusion prevention systems (IPS) - Monitors traffic and watches for unexpected behaviour such as zero-day or zero-hour attacks
• Virtual Private Networks (VPNs) - Provide secure remote access
• Unified threat management - A comprehensive security product inclusive of network firewall, network intrusion prevention and gateway, antivirus , gateway anti-spam, VPN, content filtering, load balancing, data leak prevention and on-appliance reporting

Additionally, it is essential for the government to formulate some prudent policies and laws regarding national security for administering and controlling the cyber-space.

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About MIT School of Telecom Management

The Indian Telecom market is one of the fastest growing markets in the world, providing huge potential in this booming sector across the globe having Network Operators, Infrastructure Companies, Telecom Billing Companies, Enterprise Solutions, VAS providers and service providers as its verticals this field provides ample opportunities for business and research.

Thus to prepare world class Techno Savvy business leaders of tomorrow, MIT Pune's MIT School of Telecom Management (MITSOT) "a symbol of academic excellence" has endeavoured in the field of Telecom Education and research to guide, motivate and stimulate youngsters for pursuing their glorious careers in this booming sector. MITSOT is one of the leading AICTE approved telecom institute offering PGDM & MBA. The PGDM is in Telecom Management and MBA is in Telecom Systems and Marketing.

MIT Pune's MIT School of Telecom Management (MITSOT) is an integral part of MAEER'S MIT, a pioneer in quality unaided higher education in Maharashtra. MAEER was established by Prof. Dr. Vishwanath Karad in 1983 to meet the need for a centre of scientific and educational research and engineering training. It now covers 65 institutions delivering KG to PG education to 65,000 students. This multi-campus, multi- disciplinary institute has been contributing to the industrial and economic development of our society and country for the last 27 years, and is poised to grow along with time.

MITSOT, backed by the industry, blends the technical and managerial skills of professionals to create future managers and entrepreneurs in telecommunications.

MITSOT, established in 2007, is a leading institution in the country in the area of telecommunications and "ICT" as an inclusive growth. It attracts the brightest students in the country and also caters to the rural students.

MITSOT is the first educational institute in India to be accredited as "Authorised Training Partner" by Telecom Sector Skill Council (TSSC), Government of India. MITSOT is in the process of becoming a "Nodal Centre" of IIMA IDEA Centre of Excellence (IITCOE) at IIM Ahmedabad. Two products, one each in M-health and M-Agriculture space are going to be launched for commercial production after successful lab and field trials and many more products are in the pipe line.

MITSOT produces well-groomed professionals who are fully prepared to face the "Real World" demands of telecom business, industry, government and life in general. Think of it as a perspective changing transformational experience.

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About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes.

CII is a non-government, not-for-profit, industry led and industry managed organisation, playing a proactive role in India's development process. Founded over 116 years ago, it is India's premier business association, with a direct membership of over 8100 organisations from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 90,000 companies from around 400 national and regional sectoral associations.

CII catalyses change by working closely with government on policy issues, enhancing efficiency, competitiveness and expanding business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for sectorial consensus building and networking. Major emphasis is laid on projecting a positive image of business, assisting industry to identify and execute corporate citizenship programmes. Partnerships with over 120 NGOs across the country carry forward our initiatives in integrated and inclusive development, which include health, education, livelihood, diversity management, skill development and water, to name a few.

CII has taken up the agenda of "Business for Livelihood" for the year 2011-12. This converges the fundamental themes of spreading growth to disadvantaged sections of society, building skills for meeting emerging economic compulsions, and fostering a climate of good governance. In line with this, CII is placing increased focus on Affirmative Action, Skills Development and Governance during the year.

With 64 offices and 7 Centres of Excellence in India, and 7 overseas offices in Australia, China, France, Singapore, South Africa, UK, and USA, as well as institutional partnerships with 223 counterpart organisations in 90 countries, CII serves as a reference point for Indian industry and the international business community.

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