

INFORMATION AND COMMUNICATION TECHNOLOGY– RECENT TREND AND FUTURE DEVELOPMENTS

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INTRODUCTION

The information and communication technology (ICT) has developed in four phases since 1960s. The first concept of internet, the ARPANET (Advance Research Projects Agency Network), was developed by Defence Advanced Research Project Agency (DARPA) in mid-1960s in USA. The first phase was the technology definition phase, second the network built up and capacity phase. The third is the implementation and interaction phase of useful services and applications on a broad scale. The fourth one is the network and information security phase. All phases to some extent are developed in parallel to each other as new technologies and services continuously are implemented and used.

India has taken major steps since 1988 when a World Market Policy was developed. India has continually focused on software development for export, telecommunications policy reform and the privatization of the phone companies. The liberalization process that started in 1991 has led the market forces take action and swift change has proceeded in the ICT landscape of India. Throughout the change, there have been published policies on the national level. The key published policies are as follows: (1) National Telecom Policy 1994; (2) New Telecom Policy 1999; and (3) Broadband Policy 2004.

With the above background, the following sections describe the driving forces and changing factors of trends in information and communication technology (ICT). Some insights on technologies, products and services that could be expected on the market in near future are also dealt with. A short reflection is made concerning future challenges for the Indian ICT sector. Based on the market information and anecdotal evidences, a scenario has been expected describing a potential case that might evolve over time and their impact and consequences for the economy. It may be mentioned that the scenarios and forecasts are very potent methods and should be used not in order to define the future but to prepare for the future that might evolve. On the basis of scenarios, strategies can be worked out on how to act towards the changes that could appear over time. However, the future might take unexpected directions. It is a caution that can be taken with appropriate fashion.

Drivers for Technological Changes

From the development perspectives, there are number of factors acting as drivers for technological change.

One important factor is the convergence within and between technologies and systems – fixed telecommunication converges with wireless communication and mobile telephony overtakes many of the fixed services.

Second type of convergence is between telecom, computer and the media industry creating a new industrial cluster form coined as *Infocom*. Nanotechnology and Biotechnology will be important and integrated parts of future ICT.

A third type of convergence is based on the usage of internet-protocol (IP) for all types of fixed and wireless communication, with the implication that telecommunication networks transform into computer networks. Over time the switches are exchanged to routers. Interoperability is a factor that has been identified as an important driver. Standardisation of system and components creates new possibilities to connect products from different companies and sectors such as *Telcos* (Telecommunication operators and vendors) and computer branches.

Improved connectivity is another factor meaning that all mobile devices and computer-like mobile phones connects to internet and starts to use new services and applications.

Beyond the above mentioned factors there are also a number of institutional changes that acts as technology drivers such as: (a) the creation of global production networks; (b) the formation of global innovation networks and clusters; and (c) the development of global standardization organization.

ICT – Discernible Trends

From an information and communication technology stand-point several discernible trends have been identified and divided into hardware and software areas as well as networks and services.

1. Hardware such as computers, components and elements will develop in a rapid pace in the future. The predicted introduction of quantum computing could put the logic of Moore's law aside. Instead of doubling processing power every 18 months, the growth in computing power could move in an almost vertical direction over time. Future computers will have a lot in common with the human brain both regarding logic and structure as well as how information is processed and used.
2. Nanotechnologies (deals with the structure of the size 100 nanometres or smaller) will shrink components and chips but also lead to new type of devices such as microscopic radio antennas built into fabric of clothes. The positive outcome of miniaturization is that more functionality could be added on the circuits per unit area as well as improved energy efficiency. The battery length time will be improved drastically.
3. Regarding software development, with modularization and autonomous programming the speed to develop software is much improved. The second hand market for computer programs flourishes. Large parts of already written programs are recycled and used in new forms.
4. From a network point of view broader bandwidths combined with new algorithms for traffic surveillance will improve the network transmission capability. The

transmission capacity will increase drastically over the years. The influx of new users and more capacity demanding services puts pressure on massively investment in network built up, service development and a continuously upgrading of systems. The convergence will create networks highly collaborative, personalized, intuitive and self-reflective.

5. The future internet should be seen as a place to store information in new ways. Internet is a pipe for delivery of content, ideas and thoughts. Service interaction is the next phase. Personalised services could be provided to individuals anywhere in the world.
6. Ultra intelligent electronic agents are used to seek information adapted to the individual user needs and demands. The agent will be a tool to help sorting out and refine the enormous amount of information available.
7. To improve accessibility of services and network for users from all countries, user-friendly interfaces are implemented including translation and interpretation programs in a real time basis. Artificial intelligence and virtual reality will be commodities. Holographic moving pictures in 3D could be projected from small devices.
8. Telematics, telemedicine, and intelligent machine-machine interaction will play a major part in future internet communication. Machines communicate with other machines autonomously and without human interaction.

The ICT Trend - Is it sustainable?

By disrupting traditional business models, technology is changing apace in areas such as wireless communications, sensors, and social networks. Facebook, in just over short periods, has quintupled in size to a network that touches more than 900 million users. More than 45 billion people around the world now use cell phones, and for 500 million of those people the Web is a fully mobile experience. New technologies could extend the reach of organizations, improve management decisions, and speed the development of new products and services.

The way information technologies are deployed are changing too, as new developments such as virtualization and cloud computing reallocate technology costs and usage patterns while creating new ways for individuals to consume goods and services and for entrepreneurs and enterprises to dream up viable business models.

Even as regulatory frameworks continue to evolve, environmental pressure, sustainability issues, and even financial markets have begun to track the viability of ICT scenario. Information technology plays a dual role in this debate: it is both a significant source of environmental emissions and a key enabler of many strategies to mitigate environmental damage. At present, information technology's share of the world's environmental footprint is growing because of the ever-increasing demand for IT capacity and services. Electricity produced to power the world's data centers generates greenhouse gases on the scale of countries such as Argentina or the Netherlands, and these emissions could increase fourfold by 2020. The use of IT in areas such as smart power grids, efficient buildings, and better logistics planning could eliminate five times the carbon emissions that the IT industry produces.

Smart grids can also improve the efficiency of the transmission and distribution of energy and, when coupled with energy storage facilities, could store electricity generated by renewable energy technologies, such as solar and wind. Likewise, smart buildings embedded with IT that monitors and optimises energy use could be one of the most important ways of reducing energy consumption in developed economies. And powerful analytic software that improves logistics and routing for planes, trains, and trucks is already reducing the transportation industry's environmental footprint.

Web-based companies, such as *Amazon.com*, *eBay*, and *Google*, have been early leaders, testing factors that drive performance - from where to place buttons on a Web page to the sequence of content displayed - to determine what will increase sales and user engagement. Financial institutions are active experimenters as well. Capital One, which was early to the game, continues to refine its methods for segmenting credit card customers and for tailoring products to individual risk profiles. The trend itself is self-explanatory of its sustainability.

Economic and Social Implications

Advancement in information and communication technologies and their swift adoption by common man is itself a megatrend in 21st century. The combined effects of emerging Internet technologies, increased computing power, and fast moving digital communications are new way of life. This will developed into new business models and logics of behaviours. It will have a direct impact on efficiency and productivity in all sectors and on all levels. Ideas and thoughts can be spread to a large number of people worldwide more or less immediately.

Content could be exchanged widely. A free flow of information can bridge the gap between cultures and organizations. An overall improved communication also leads to cultural and social challenges to deal with. For some parties, the development is encouraging, and for others can be seen as a threat.

Internet will probably be divided into one 'open and free' internet and one closed and regulated ditto in parallel with the open network. The *Internet 2* for instance is an initiative to connect universities and research institutions.

Future ICT Challenges for India

India poised to play a major role in the world economy. Especially China and India with their high growth rates respectively, will act as centre of gravity.

India is one of the top nations in the world regarding software development. The integration between telecom and computing, the transformation of hardware into software as well as an all connected and integrated network will need to a change of business logic. In this aspect, China will pose a direct challenge to India's role.

The cyber space is foreseen to be a prime arena for conflicts fuelled by political, economic, religious and national manifestations, a tendency that increases over time. A cyber conflict could diffuse rapidly over borders and lead to consequences concerning security policy.

India and other rapidly developing Asian nations that invest heavily in ICT are vulnerable to cyber attacks. Some of them are unknown today but others could to some extent be foreseen like virus attack and Phishing.

In the forthcoming years, a lot of efforts will be put into better and more secure web servers, new identifications and authentication processes using for instance biometrical and DNA techniques. Identity management will be a crucial area to develop. Network security to avoid interception and manipulation of information is the major challenge for ICT in India.

Concluding Remarks

The pace of information technology and business challenges will only accelerate, and the impact of the discernible trends described above will broaden and deepen. For some entities, ICT will unlock significant competitive advantages; for others, dealing with the disruptions that erupts will be a major challenge. The broad message is that organisations should incorporate an understanding of the trends into their strategic thinking to help identify new possibilities, invent new ways of dealing with business, and compete with an ever-growing number of innovative rivals.

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