Latest Trends in Communications

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Abstract — **If humans are the only internet users of the future, then the total user base might conceivably double, but is unlikely to go beyond two billion active users in the near future. On the other hand, if "things" become active internet users on behalf of humans, then the number of active connections could be measured in terms of tens or hundreds of billions.**

The internet and other data transmission services (*e.g.* SMS, MMS), initially the purview of the developed world, are also gaining market share in developing economies, boosting information and communication access and increasing demand for bandwidth.

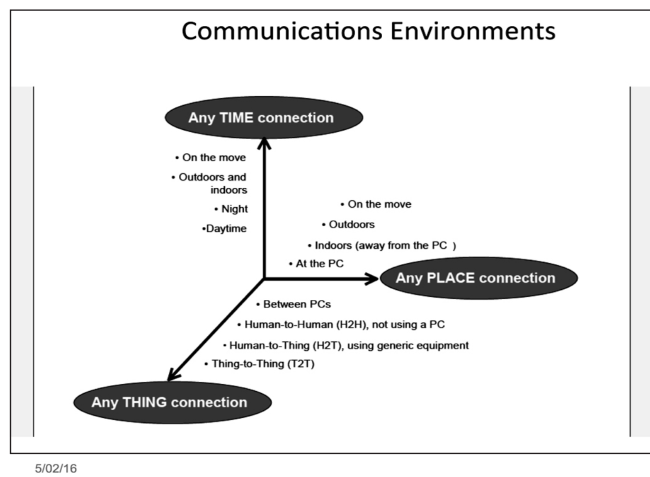
With Internet of things, it is expected that there will be 300 billion things connected to network by 2025. There will be Tsunami of data to meet the demands of internet of things and other smart phone applications.

Keywords: Internet, IOT, 5G, New Generation Networks, Software Defined Radio, Smart Cities, Digital India

INTERNET began in the late 1960s as a link between a handful of university computer centers. In the 1970s and 1980s, the use of the Internet was dominated by e-mail and file transfer, and the number of users was counted in thousands. In the 1990s, web browsing became dominant and users were denominated in millions. The Internet as we know it today will radically change over the next decade. As of the end of 2015, there were some 3.36 billion internet users worldwide. Moreover, mobile phones, of which there were over 2 billion at the end of 2015, are being used more and more as devices for internet access. This creates new applications and services hitherto unknown, through both 2G systems and a growing subscriber base for IMT-2000 (3G) systems.

The internet and other data transmission services (*e.g.* SMS, MMS), initially the purview of the developed world, are also gaining market share in developing economies, boosting information and communication access and increasing demand for bandwidth. Today, we are heading into a new era of ubiquity, where the "users" of the internet will be counted in billions and where humans may become the minority as generators and receivers of traffic Instead, most of the traffic will flow between devices and all kinds of "things", thereby creating a much wider and more complex "Internet of Things".

If humans are the only internet users of the future, then the total user base cited above might conceivably double, but is unlikely to go beyond two billion active users in the near future. On the other hand, if "things" become active internet users on behalf of humans, then the number of active connections could be measured in terms of tens or hundreds of billions.



I. INTRODUCTION

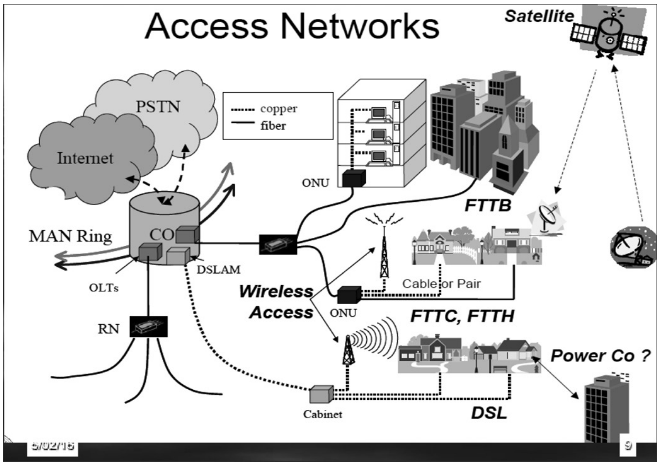
THE TRENDs in Communications can be classified into three parts:

- Trends in Communications technologies
- Trends in Data management and
- Trends in Operators perspective to meet the challenges with minimum costs and manage the networks efficiently.

First we will take up the communication technologies. As we all know the communication can be People to people: This has been the trend since the civilization started as people were communicating with each other with different mans of communications.

In the present day technological world, the simple and universal set of network can be represented as in Figure 2.

As we can see there is a central office Next Generation Networks (NGN) which has different types of connections depending upon the network voice, data fibre etc. All the connections are part of access technologies.



II. ACCESS TECHNOLOGIES

In people-to- people communication, the speech is transmitted through the network called Access Network. There have been fixed phones, which are location based and were identified by the address or place where the phone is installed. In seventies came the wireless technology that was analogue as below:

- TACS: Total Access communication system. This was working in UK in the frequency band 890-915 MHz and 935-960 MHz
- NMT Nordic Mobile Telephone (Europe) This was developed in the frequency band of 453-457.5 MHz and 953-960 MHZ
- AMPS: Advanced Mobile Phone System 824-849 MHz and 869-894 MHz.

All these technologies being analogue, there were difficulties of capacity and quality of speech and interference issues.

This was First generation of mobile system called 1st Generation.

2nd Generation: To overcome many of the issues, European countries (ETSI) joined hands and started to develop a digital system. Many European companies like Nokia, Alcatel and Ericsson were given the task of development while the specification was being developed. This was called Groupe Speciale Mobile GSM System. It is based on TDMA technology (Time division Multiple Access)and started its operations in 1988-90 time frame.

In USA, Qualcomm was trying to develop second generation digital CDMA system (Code Division Multiple Access). The CDMA was developed in Freq. band 824-869 MHz while GSM was developed in 890-915 and 935-960 MHz and the 1710-1785 and 1805-1880 MHz to meet capacity demand.

Many countries chose the GSM technology and this made the roaming between these countries feasible. The demand for CDMA 2G technology could not reach many countries basically due to delay in its development and cost issues. The CDMA technology was owned by Qualcomm and was not open standards as the GSM technology.

Therefore, India also adopted GSM technology. It came to be known as Global System for Mobile Communications (GSM).

TOTAL telecom Subscribers June 2015

- **Total subs wireless and wire line 1007 mil**
- **Wireless Subs. 980.8 mil**
- **Urban Subs. 584.21 mil**
- **Rural Subs. 422.75 mil**
- **Tele density total 80 %**
- **Tele density Urban 149.7 %**
- **Tele density Rural 48.66 %**

(Source TRAI)

In Nineties, the internet and TCP IP technology was so popular resulting in multifold increase in Data because people were using data for emails and transfer of large files. Therefore, the need for data was felt and industry started working on providing data on existing 2G networks. ITU also started working on drawing specifications called IMT 2000. This development was started in 2000 and called 3G technology. In the meantime to meet immediate need for data EDGE (Enhanced datarates for GSM evolution) was developed to give data speed of 144 kbps and it was called 2.5G (This name was given by industry) to distinguish from 2G and 3G.

ITU standardized the 3G technology based on CDMA as it was considered to be spectrum efficient and more secured. Since majority of networks were working on GSM 2G technology, a 3GPP (Third generation Partnership group) was formed to develop specification for system called UMTS (Universal Mobile Telecom System). The technology recommended was called WCDMA (Wideband CDMA).

Qualcom also started working on CDMA 2000 to meet the ITU Spec. In its wisdom ITU developed specification and made it technology neutral. The data speeds in 3G are 2 Mbps.

As need for data increased, the speed as given by 3G technology was found slow. The need for next generation was felt and it is called 4G technologies. 4G technology was also termed as Long Term Evolution and a speed of 100 Mbps was specified. 3GPP group was working on the technology and in 2010 this came into existence. 4G take into account data packaging and is an all IP technology.

To meet the need for higher BW the freq. range for 4G technology is 2.5 GHz. From 2005-2010 the industry worked on pre4 G called as 3.5 G and technology called HSPA(High Speed Packet Access) was developed.

4G technology is developed on OFDMA (orthogonal Freq. Division Multiple access) and for antenna it is based on MIMO (Multiple input and multiple output).

The tree below gives growth of 1G to 4G technologies

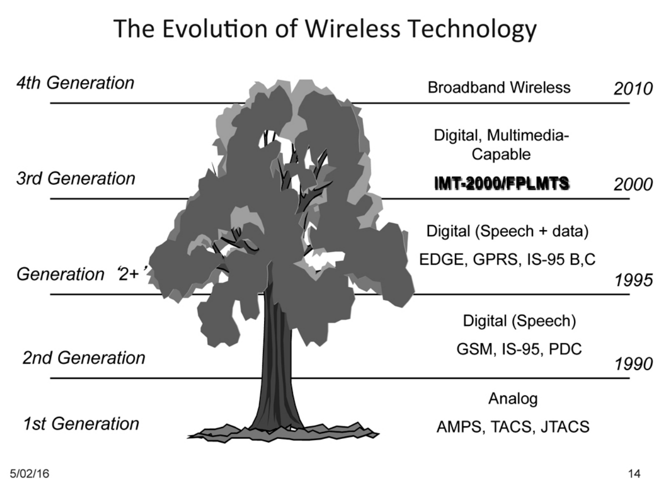


Figure 3. Evolution of Wireless Technology.

We can see that a new mobile generation has appeared approximately every 10th year since the first 1G system, Nordic Mobile Telephone, was introduced in 1981. The first 2G system started to roll out in 1991, the first 3G system first appeared in 2001 and 4G systems fully compliant with IMT Advanced were standardized in 2012. The development of the 2G (GSM) and 3G (IMT-2000 and UMTS) standards took about 10 years from the official start of the R&D projects, and development of 4G systems started in 2001 or 2002.

The proliferation of video streaming and other social media is making even 4G slower and the development of next generation of wireless access networks are being designed. The 5G will give speeds as high as 1GB /sec.

5G will spearhead the use of cognitive radio techniques to allow the infrastructure to automatically decide about the type of channel to be offered, differentiate between mobile and fixed objects, and adapt to conditions at a given time. In other words, 5G networks will be able to serve the industrial Internet and Facebook apps at the same time.

Wireless communication algorithms are implemented using a wide spectrum of building blocks such as: source coding; channel coding; modulation; multiplexing in time, frequency and code domains; channel estimation; time and frequency domainsynchronization and equalization; pre-distortion; transmit and receive diversity; combat and take advantage of fading and multi-path channels; intermediate frequency (IF) processing in software defined radio, etc.

Major design objectives for future Networks

- Implementation of massive capacity and massive connectivity
- Support for an increasingly diverse set of services, applications and users all with extremely diverging requirements
- Flexible and efficient use of all available non-contiguous spectrum for wildly different network deployment scenarios
- Multiple access and advanced waveform technologies combined with coding and modulation algorithms
- Interference management
- Access protocols
- Power needs of terminals and equipment-Economizing Power.
- Service delivery architecture
- Mass-scale MIMO
- Single frequency full duplex radio technologies
- 5G devices
- Virtualized and cloud-based radio access infrastructure
- An adaptive network solution framework will become a necessity for accommodating both LTE and air interface evolution;
- Cloud, Software Defined Network (SDN) and Network Function Virtualization (NFV) technologies will reshape the entire mobile ecosystem;
- and 5G will speed up the creation of massive-scale services and applications.

III. 5G NETWORKS

General industry expectations are for the first 5G services to go live around 2020.

SK Telecom South Korea has announced the use of 5G technology in their network in 2018 during Winter Olympics.

While it's quite possible that some of the technology, which will comprise the 5G standard, will be found in commercial services that soon, it's unlikely to be formally called 5G as the final ratification of the standard is unlikely to have happened by then. Of course that won't stop the marketing people jumping on the bandwagon and the term 'pre-5G' is already being used liberally.

One of the main reasons for this is the wide array of technologies that are already being positioned as likely contributors to the eventual standard. There will be two features worth mentioning for successful implementation of 5G technology. One of them is spectral efficiency and the other being capacity to meet the anticipated growth of the Internet of Things (IoT) consequently increase in traffic.

Another interesting feature required is the support of NFV/ SDN, SON, unlicensed spectrum and full duplexing. In other words 5G is going to be the product of a large number of technologies, but at its core it needs to solve the problem of carrying an enormous traffic.

The move to an all IP mobile environment is likely to remove communication barriers,
both geographical and technological. The technology will support borderlessmobility services enabled by an all IP mobile environment.

It will enable seamless mobilevoice and data communication services between mobile networks and Wi-Fi serviceproviders internationally". The spread of VoLTE will ensure subscribers never have to leave an IP network while using their devices, which in turn opens up a number of new opportunities for dynamic switching between cellular and
Wi-Fi.

The road to 5G will be a long one, but there's no question we're already on it. While the consensus is for commercial 5G services not to appear until 2020 or later, claimed 'pre-5G' technologies are already being developed and marketing professionals across the telecoms industry are keen for their brands to be associated with 5G today.

Many of the challenges faced by previous generations of mobile technology need to be confronted once more, such as standardization, cost of roll-out and consumer education. But the potential rewards are greater than ever as more people and devices are set to do more things over more networks. Commerce is set to be increasingly defined by mobile technology so pretty much everyone has a stake in the development of 5G.

Recently, voice over LTE, or VoLTE, has become tantamount to being the future of voice for operators, as well as a potential bastion for securing revenues from what has become a hemorrhaging revenue stream for operators. Voice services as a meaningful source of income have been losing relevance to operators, for the best part, as a new generation of tech-savvy users lean increasingly towards over-the-top instant messaging platforms, coupled with a publicperception of unreliability and poor quality of service being offered up by traditional circuit switched voice systems.

While data networks have, deservedly, received countless upgrades and technological advancements in recent years, unsurprising considering the proliferation and monetization opportunities of data services over the past few years; voice services seem to have slowly died a death, and haven't received an upgrade or overhaul of note for a decade or more, since UMTS and GSM. VoLTE could well present an opportunity for operators tomake voice an opportunity for monetization once again for mobile.

IV. MOBILITY AND NGN

At present, the underlying mobility of services remains limited: end-user services other than voice are hardlyportable across networks. This functionality is central to exploiting thing-to-thing communications. In thisrespect, next-generation networks hope to offer mobility much more broadly. "Generalized mobility" isa term closely associated with NGN. It denotes the possibility of seamless and ubiquitous access to services, irrespective of location and the technology used.

NGN is a broad concept, and there are several definitions of NGN at this time. ITU formally defines NGN asa "packet-based network able to provide telecommunication services and make use of multiple broadbandtransport technologies in which service-related functions are independent from underlying transport-related technologies". In general, most analysts describe NGN as a multi-service network based on Internet Protocol (IP) technology. The fundamental difference between the networks of today and NGN will be the full transition they imply from current circuit-switched networks to packet-based systems such as those using IP (Table 1). A number of network operators havealready begun replacing their Public Switched Telephone Network (PSTN) equipment with next-generationEquipment.

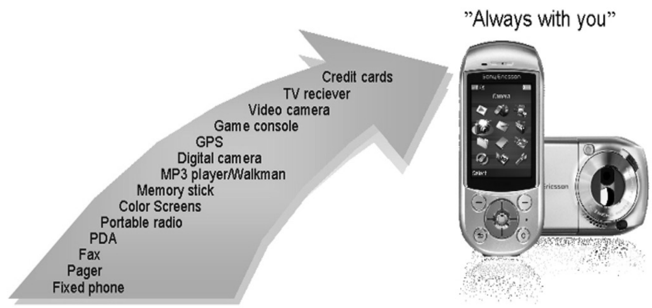
TABLE 1 -- CONTRASTS BETWEEN TODAY'S PSTN NETWORK AND TOMORROW'S NGN

Today's PSTN network	Next-generation Networks
Circuit-switched.	Packet-based, based on Internet Protocol (IP).
Limited mobility of end-user services.	Broad-based 'generalized mobility'.
Vertical integration of application and call control layers, with dedicated networks.	Horizontally-integrated control layers, with simultaneous delivery of applications. Service-related functions independent of transport-related technologies.

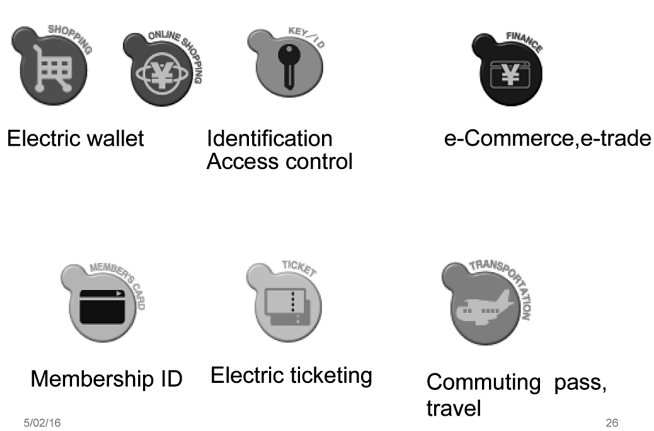
V. SMART PHONES

All the benefits of Social networking smart cities, e-governance etc. are only possible due to development of Smart phones with touch technology. The man behind the touch phone technology implementation in phones id Steve Jobs who was CEO of Apple Inc.

His prediction has revolutionized the world with smart phone being made available and its proliferation. Apps on phones and killer applications are helping citizens to fully exploit the use of smart phones.



Mobile applications

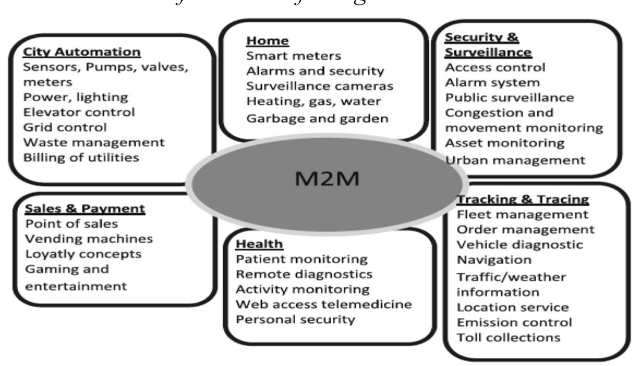


All these developments are increasing the load on bandwidth. With Internet of things, it is expected that there will be 300 billion things connected to network by 2025. There will be Tsunami of data to meet the demands of internet of things and other smart phone applications. There will be need for newer technologies to meet the demand of huge data and already 6G and 7 G technologies are being talked. The 6G and 7 G will integrate satellites into the access networks making whole world a real Global village.

VI. INTERNET OF THINGS

There is large demand arising for automation of all processes and machines talking to machines. Even today e-commerce, is M@M communication. The machines will become things . Anything will be connected to internet.

The Data needs of Internet of things:



The IoT is the network of dedicated physical objects (things) that contain embedded technology to sense or interact with their internal state or external environment. The IoT comprises an ecosystem that includes *things, communication, applications and data analysis.* (Kevin Ashton first used the term Internet of Things in 1999. Refers to uniquely identifiable objects (things) and their virtual representations in an Internet-like structure)

VII. TRENDS IN DATA

The figure below shows the data generated on internet in 60 seconds. DATA Storage is very complex, and indeed, not only does it entail managing capacity and figuring out the best collection and retrieval methods, it also means synching with both the IT and the business teams and paying attention to complex security and privacy issues.

Cyber Security

- Everything connected to Internet is vulnerable: Retailers, Banks, Technology companies are getting hacked.
- Needs Better Cyber security: Techniques beyond current Firewall-like defenses
- Better encryption, Authentication Schemes.

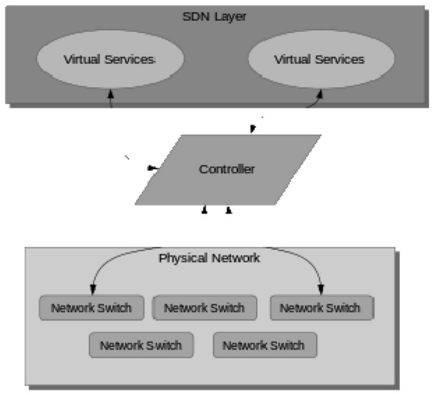
Customers are becoming wary of Data Secrecy and security issues.

VII. TRENDS IN INDUSTRY

The industry has to implement all these developments in the technology to meet the needs and aspirations of its customers. All these implementations will involve huge investments. The operators have to decrease capital costs and, therefore Self Organizing networks (SON) are being implemented

- A self-organizing Network (SON) is an automation technology designed to make the planning, configuration, management, optimization and healing of mobile radio access networks simpler and faster.
- Self Configuration
- Self Healing
- Self Optimisation
- Operators benefit from significant improvements in terms of both CAPEX, and later OPEX.

The operators are not going to build huge data storage systems as it involves lots of space , power and investments. Therefore Cloud Technology is helping these operators. In addtion to self Organising networks, the operators are also implementing the newer methods of network maintenance by utilising SDN (Software Defined Networks and NFV (Network Functions Virtualisation). SDN allows network administrators to manage network services through abstraction of lower level functionality. This is done by decoupling the system that makes decisions about where traffic is sent (the control plane) from the underlying systems that forward traffic to the selected

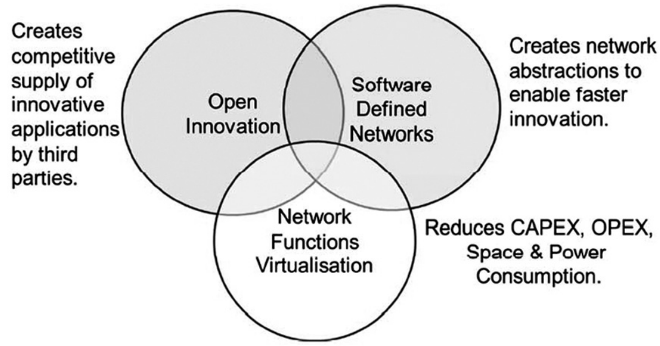


destination (the data plane). The inventors and vendors of these systems claim that this simplifies networking.

SDN requires some method for the control plane to communicate with the data plane. One such mechanism, OpenFlow, is often misunderstood to be equivalent to SDN, but other mechanisms could also fit into the concept. The Open Networking Foundation was founded to promote SDN and OpenFlow, marketing the use of the term cloud computing before it became popular.

The controller acts as an interface between the physical network and the SDN layer. As elastic cloud architectures and dynamic resource allocation evolve and as mobile computer operating systems and virtual machines usage grows, the need has arisen for an additional layer of software-defined networking (SDN). Such a layer allows network operators to specify network services, without coupling these specifications with network interfaces. This enables entities to move between interfaces without changing identities or violating specifications. It can also simplify network operations, where global definitions per identity do not have to be matched to each and every interface location. Such a layer can also reset some of the complexity build-up in network elements by decoupling identity and flow-specific control logic from basic topology-based forwarding, bridging, and routing.

In recent years, user expectations for "anywhere, anytime" access to business and entertainment applications and services are changing the service model needed by carrier network operators. For example, e-commerce applications are now adopting cloud technologies, as service providers continue incorporating new business applications into their service models. For entertainment, video streaming content now includes not only traditional movies and shows, but also user-created content and Internet video. The video delivery mechanism is evolving, as well, to include streaming onto a variety of fixed and mobile platforms. Feature-rich mobile devices now serve as e-commerce and entertainment platforms in addition to their traditional role as communication devices, fueling deployment of new applications, such as mobile TV, online gaming, Web 2.0 and personalized video.



To remain profitable, carriers need to offer value-added services that increase the average revenue per user (ARPU), and to create these new services cost-effectively, they need to leverage the existing datacenter and network infrastructures. This is why the datacenters running these new services are becoming as critical as the networks delivering them when it comes to providing profitable services to subscribers.

Datacenter and carrier networks are quite different in their architectures and operational models, which can make unifying them potentially complex and costly. According to The Yankee Group, about 30 percent of the total operating expenditures (OpEx) of a service providers are due to network costs, as shown in Figure above. To reduce OpEx and, over time, capital expenditures (CapEx), service providers are being pushed to find solutions that enable them to leverage a more unified datacenter-carrier network model as a means to optimize their network and improve overall resource utilization.

Virtualization of the network infrastructure is one strategy for achieving this cost-effectively. Virtualization is a proven technique that has been widely adopted in enterprise IT based on its ability to improve utilization and operational efficiency of datacenter server, storage and network resources. By extending the virtualization principles into the various segments of a carrier network, a unified datacenter-carrier network can be fully virtualized — end-to-end and top-to-bottom — making it far more scalable, adaptable and affordable than ever before.

Leveraging the virtualized datacenter model to virtualize the carrier network has several benefits that can help address the challenges associated with a growing subscriber base and more demanding performance expectations, while simultaneously reducing CapEx and OpEx. The approach also enables carriers to seamlessly integrate new services for businesses and consumers, such as Software-as-a-Service (SaaS) or video acceleration. Google, Facebook and Amazon, for example, now use integrated datacenter models to store and analyze Big Data. Integration makes it possible to leverage datacenter virtualization architectures, such as multi-tenant compute or content delivery networks, to scale or deploy new services without requiring expensive hardware upgrades.

Incorporating the datacenter model can also enable a carrier to centralize its billing support system (BSS) and operation support system (OSS) stacks, thereby doing away with distributed, heterogeneous network elements and consolidating them to centralized servers. And by using commodity servers instead of proprietary network elements, carriers are able to further reduce both CapEx and OpEx.

Another trend in virtualized datacenters is the abstraction being made possible with software-defined networking, which is enabling datacenter networks to become more manageable and more open to innovation. SDN shifts the network paradigm by decoupling or abstracting the physical topology to present a logical or virtual view of the network. SDN technology is particularly applicable to carrier networks, which usually consist of disparate network segments based on heterogeneous hardware platforms.

NFV is an initiative being driven by network operators with a goal to reduce end-to-end network expenditures by applying virtualization techniques to telecom infrastructures. Like SDN, NFV decouples network functions from traditional network elements, like switches, routers and appliances, enabling these task-based functions to then be centralized or distributed on other (less expensive) network elements. With NFV, the various network functions are normally consolidated onto commodity servers, switches and storage systems to lower costs.

NFV and SDN are complementary technologies that can be applied independently of each other. Or NFV can provide a foundation for SDN. By using an NFV foundation combined with SDN's separation of the control and data planes, carrier network performance can be enhanced, its management can be simplified, and new services can be more easily deployed.

VIII. DIGITAL INDIA

- Digital India is an initiative by the Government of India to ensure that Government services are made available to citizens electronically by improving online infrastructure and by increasing Internet connectivity. It was launched on 1 July 2015
- The initiative includes plans to connect rural areas with high-speed internet networks.
- Digital India has three core components.

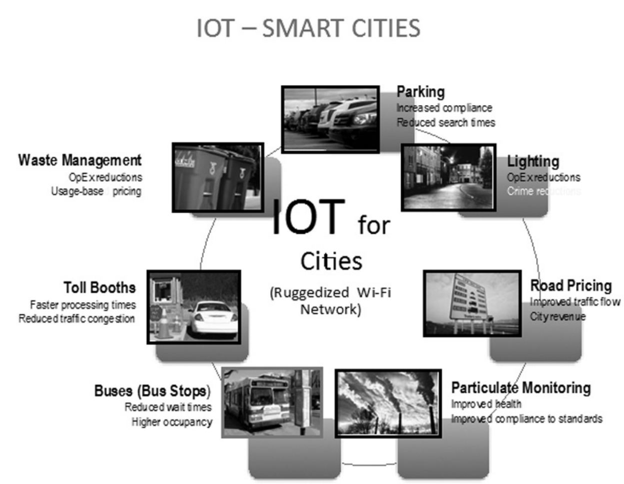
The creation of digital infrastructure
- Entertainment-real time entertainment, audio streaming,3D gaming
- Utility-remote management like security
- E-governance-Govt. sector

Delivering services digitally
Digital Literacy

Pillars of Digital India:
- Broadband Highways
- Universal Access to Mobile Connectivity
- Public Internet Access Program
- e-Governance – Reforming Government through Technology
- eKranti - Electronic delivery of services
- Information for All
- Electronics Manufacturing
- IT for Jobs
- Early Harvest Program.

IX. SMART CITIES

Smart Cities are those that integrate information communications technology across three or more functional areas like roads, buildings, water and so on with technology to enrich the lives of its citizens. Creative platforms and killer apps have helped reduce traffic, parking congestion, pollution, energy consumption and crime. They have also generated revenue and reduced costs for residents and visitors.



Please see the link below about smart cities in India
- http://www.ndtv.com/video/player/ndtv-specials/smart-technology-and-the-concept-of-smart-cities-in-india/374701

The Government of India has decided to make 100 cities in India as smart cities. The first phase of project Smart India with 20 cities list has been announced. It will take 3-4 years to fully develop smart city with a financial burden of about Rs.2000 crores

Smart Cities- Strategy: According to the United Nations, the global population is expected to grow from seven billion today to 9.3 billion by 2050, and the world's cities will have to accommodate about 70 percent more residents. The traditional ways of dealing with the influx—simply adding more physical infrastructure—won't work, given limited resources and space.

New ways of incorporating technology will be required to provide urban services. In the future, there will be less emphasis on physical connections and more on access to virtual connections.

X. CONCLUSION

As the internet first spread, users were amazed at the possibility of contacting people and sending information across oceans and time zones, through e-mail and instant messaging, with just a few clicks of a mouse. In order to do so, however, they typically had to sit in front of a computing device (usually a PC) and dial-up to the internet over their telephone connection. Today, with mobile internet services and the deployment of higher-speed mobile networks such as 3G (IMT-2000) and 4G (LTE), users can connect from almost any location. They can also access networks at any time, through always-on connectivity (wired and wireless broadband). The next step in this technological revolution is to connect inanimate objects and things to communication networks. This is the vision of a truly ubiquitous network–"anytime, anywhere, by anyone and anything". In this context, consumer products might be tracked using tiny radio transmitters or tagged with embedded hyperlinks and sensors. The connectivity will take on an entirely new dimension. Today, users can connect at any time and at any location. Tomorrow's global network will not only consist of humans and electronic devices, but all sorts of inanimate things as well. These things will be able to communicate with other things, e.g. fridges with grocery stores, laundry machines with clothing, implanted tags with medical equipment, and vehicles with stationary and moving objects. It would seem that science fiction is slowly turning to science fact in an Internet of Things based on ubiquitous network connectivity.

Manjit Singh was President of Himachal Futuristic Communications Ltd. (HFCL), heading HFCL's technical operations and business development. He directed the successful implementation of CDMA, GSM and WLL equipment including PDSN, billing, customer care, and SMS/VMS systems.
He served on the technical groups of two world telecom forums: the International Telecommunications Union and the APT Asia Pacific Telecom. Earlier, he worked for Compton Greaves Limited as Vice President Telecom Services.
He served Government of India for over 27 years in key positions of national policy, Director responsible for maintenance and switching in the Ministry of Telecommunications and General Manager in charge of two large telecom circles in North India. He was responsible for planning, installation, commissioning, and monitoring of several large telecom networks in this period.
As Chair of the India DECT Forum from 1997-1998, he played a pivotal role in promoting Wireless Local Loop technology in India and abroad. Mr. Singh is a Fellow of the IETE and holds a B.Sc. (gold medallist) degree in Electrical Engineering from the University of Punjab.