Ambitious and Challenging Targets for New Generation Network

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Abstract: Today, the Internet has penetrated almost all the ins and outs of social life, has changed work, communications, social influence and the lifestyle of humankind. However, it is still short of flexibility, transparency etc., due to network address translator overuse, masschanges, uncomfortable protocols, and so on. Hence, more research is necessary into future telecommunications networks based on contemporary networks accompanied by new requisitions and new designs that are compatible with today’s and tomorrow’s demands. This paper researches a new vision of the telecommunication network of the future, its effects on human life and society, and the targets to achieve a new generation network (NwGN). In the paper, we also propose orientation towards an NwGN from the current networks, especially with Vietnam’s telecommunications networks.

Keywords: Future internet, Network, New generation, NwGN

1. Introduction

In the modern age of the intellectual economy, information has become extremely important. The demand for information exchange is a vital condition of all activities in society. Hence, the telecommunication (telecom) field has to keep ahead in serving these social developments. In that trend of the very strong development of the telecom network, we can realize that advanced telecom services always participate in the progress of society. However, the telecom network now faces huge challenges. Designed and utilized since the 1960s, the current telecom network suffers from a lot of weakpoints and drawbacks (i.e. low transmission speeds, incompatible designs, and a limited ability to convey information).

*one exabyte = one billion gigabytes [1]*

At the same time, research by Cisco Systems, Inc. [1] suggests that telecom traffic is going to explode in the next few years. Cisco forecasts that data traffic will exceed one thousand exabytes in 2016, and will reach 2,300 exabytes in 2020 (see Fig. 1). This is a very high traffic with an average increment of about 22% up to 2020.

With that burst of telecom traffic [1-3] accompanied by an extremely large number of hosts and links, the current telecom network is becoming a “tight shirt”. The work of repairing, reforming, or making other local changes only makes it work well locally, and only temporarily. Steady satisfaction of the demand needs a global solution as well as the participation of the whole community. Projects have begun in some countries, like the United States, Japan,

Fig. 1. Forecast data traffic in network up to 2020 [1].
France, etc., to basically solve disputable and challenged problems in the current telecom network, and to research and develop the design of a future telecom network that can replace the current one. That future telecom network could also be called the “Future Internet” or the “new generation network”, but the main purpose of the research consists of a long-term plan with the design of a brand-new network.

These projects begin and speed up building the new network called the “new generation network” or NwGN. Some projects, like AKARI ([11]), FIND ([4]), FP7 ([5]), New Arch [19], have presented targets for the network community for building an open network [4, 5], and towards a global telecom network that can both satisfy present requirements and fulfill future demand.

In 2009, the International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) founded a special group to work on this problem, called the Focus Group on Future Network (FG-FN). This group proposes a general and strategic vision for the future network, which basically responds to four main problems: environmental, service, data, and social and economic awareness, as shown in Fig. 2 [17].

The orientation of research as well as designing, structuring, network building, etc., is concentrating on these demands, to delve into and serve more of the demands from the social community. This paper concentrates on detailed analysis of the NwGN vision and the targets that the new network can hit to ensure it satisfies the rapid developments in society for the near future. These targets are also aimed at by all countries, all producers, manufacturers and providers in the future. Based on that, this paper proposes some strategic orientations, a new vision, and new thoughts about the telecom network and technology. Besides, it proposes asymptotic ways for the Vietnam telecom network’s progress towards the NwGN with a policy of investing effectively and ensuring steady long-term development for the economy in the new age of information.

2. New Vision of NwGN

Other projects and research have been in progress since 2000 (see Fig. 3).

Expecting to be better than the present network and to resolve various social issues, the NwGN aims to maintain a prosperous civilization, to develop the abilities of individuals and all of society, and to create an affluent life for all people. Furthermore, this network is orientated
towards building a strong network for information and communications, which encourages the development of human society. The trends of changing from static to dynamic, from fixed to mobile, from just one point to ubiquity, have become the general trends in the telecom network, which encourage popularity in society with various kinds of connections. These trends will strongly augment the number of users. Users not only enjoy telecom services passively, but they also select many kinds of services more actively.

In recent years, we have seen an explosion of new information services in the network, such as e-commerce, Over-the-Top (OTT) services, e-banks, and so on, which deeply penetrate human lives. To address these obvious demands for information, the capacity of the network must be improved and strengthened, corresponding to the new vision of the NwGN. That is really a steady resolution for this issue, and this process is in researching, designing and applying these targets.

Moreover, by accepting the diversity of people, as well as the diversity of human services, the NwGN is the basic infrastructure for developing society strongly and continuously, now and up to the year 2020 and after.

With that vision, the main orientations towards solutions and technology need to be as follows:

- new notions about the telecom network
- targets and real values of the telecom network
- sharing new awareness about related solutions to social problems in the future
- building an image of a society of information and communications in the future
- building a new generation network that has a greater vision for the future, and that can satisfy the mobility, ubiquity, and diversity, etc., for everything in the network

Besides, building the value of the NwGN plays an important role. It creates a strategic vision, and promotes organizations, individuals, and researchers who take part in building the NwGN and creating new values, such as diminishing the passive factors of present social problems, optimizing the active and potential factors, and contributing to a general harmony in social values.

The new values cited above are simply building a harmonic society in which diversity is respected and cooperation between members in that society is promoted.

3. Capacity and Targets of NwGN

With the predetermined vision from the previous section, the capacity of the NwGN is that this network can enhance the basic values of a society in which information and communications have a big role. As proposed by the National Institute of Information and Communications Technology (NICT) [18], the items investigated for the NwGN cover almost all social issues, now and in the future, as seen in Fig. 5.

To achieve these requirements, the proposition of specific targets for the NwGN is very important, especially for a new network with the ability to serve all demands for information everywhere and all the time at high speed and with high quality. The specific targets have largely been determined by projects in many countries, as mentioned in section 1, with some main target groups, such as: social targets, access spaces, network infrastructures, environment and energy, technology and technical solutions, and security and data safety.

To achieve social targets, the NwGN must be a network that can serve billions of people. Once accessing and using the network become popular, small children or even old people can all use the network, and can become “members” of the NwGN. From that, we can preview a world of open information, in which all demands, all communications, and behavior of all people who take part in the network will be served and processed in accordance with a vast society of information [4, 7]. The NwGN at once satisfies “hot” social requirements and has the ability to assist with social solutions using high-speed
Anh et al.: Ambitious and Challenging Targets for New Generation Network communications. Hence, the NwGN needs to improve the capacity of the network to serve information according to age, and to tighten the so-called “digital divide” (the gap in the ability of some members of society to use the network) based on rules of the economy, technical design, and real requirements in policy planification [9]. To do that, we should build and promote developing and researching assistance by providing forums and instructing development [10]. Besides, the NwGN should be friendly with environment for network users [6].

About targets for access spaces, the NwGN is a network that can be accessed from anywhere and by all kinds of devices: mobile phones, fixed line phones, wireless devices, etc., and is called a ubiquitous network [11], wherein all kinds of services use the same infrastructure. In other words, a network infrastructure that provides the requested services with ultra-high speed according to human requisitions [18].

About the target for a network infrastructure, it needs to be a new global, unified, multipurpose and multiform infrastructure [11], a high-quality infrastructure that can create real value in life, that can address the real requirements of society (like healing, e-government, e-education, e-schools [18]), and that can be an intelligent and versatile network [5, 6, 11].

About targets for the environment and energy, these require a lot of care in the projects, because they will determine whether moving to the NwGN succeeds or not. With the criterion that energy consumption be smaller and smaller, the NwGN needs to be an “energy-saving” network by optimizing the resources of wave-space, network-space, and so on, as proposed by [18, 11, 19]. NICT [18] proposes targets for a “green” network with criteria on energy savings, energy reproduction, etc., for building the new network in order to convince countries, especially developing countries, to utilize and apply the NwGN.

Otherwise, the NwGN is still a network that can be sustainable in spite of climate change and other environmental factors, and that can withstand all severe weather conditions [5].

About targets for technology and technical solutions, it is clear that the NwGN needs to apply state-of-the-art technology, and the most effective technology, in order to serve network users with big investments in research and development for the most effective network in the future. New transmission technologies, like the IP over Multiprotocol Label Switching (IPoMPLS), the optical transport network (OTN), etc., combined with all-optical switching technology, optical buffers, nano-level wavelength multiplexing with thousands of wavelengths in one optical fiber to help provide high speed of millions of Gigabit per second (Gbps) in fiber transmission, will help change the face of the current telecom network. New transmission technologies will help the core network achieve transmission rates in the billions of megabits per second, will make network performance better, will satisfy the demands of future traffic (as shown in Fig. 1) and will help to build a modern, high-speed and multi-tasking network.

Besides the above groups of targets, targets for security and data safety are also very important tasks for the NwGN. At present, almost all aspects of modern life are associated with a telecom network, such as money transfers, ratings, electronic purses, even e-government and weapon systems control and so on. So, these targets are always set first. In the NwGN, the demand for security is required at such a high level that the system can be safe in very severe conditions, such as disasters or under attack. Although upgrading security capacity will incur high costs, it is needed in order to be safe, to ensure security at a high level, and to ensure the rights of users who utilize the NwGN for diversified purposes.

With this very ambitious group of targets, it is hoped that the NwGN will become a multipurpose network on which the big economies, the countries of the world, will be based, and they will concentrate on building advanced standards for themselves. Besides, the targets above form a sample network of the future so that researchers, telecom devices, and producers have specific orientations, and from that, they can switch to the new network at the lowest price and with the highest effectiveness.
4. Proposals for Building the Strategy of Telecom Network Development Towards the NwGN

4.1 Strategic Orientation of Telecom Network Development

Moving the current telecom network towards the NwGN is mainly a way of developing the current telecom network to satisfy all demands in the future. Planning policies of network development in the next stage needs to aim at network modernization and network core reinforcement. Recommendations from ITU-T [17, 22] provide the standard model for the NwGN, with fully ambitious targets. These targets are the goals current networks try to achieve as they plan a telecom network development strategy leading towards the NwGN.

At present, although there are a lot of projects in many countries, the concrete model for the NwGN is still “at the first level,” with proposed targets. Depending on the characteristics of each country or area, we have different asymptotes. Hence, the way to the NwGN must be realized step by step, asymptotically towards NwGN targets recommended by the ITU-T [17, 22] and proposed in Section 3.

4.2 Asymptotic Proposals Towards the NwGN from the Current Telecom Network

4.2.1 Developing and Applying Modern Technology

Technically, we must build a platform based on integrating all present systems into a new platform, as well as opening up a strong capacity for satisfying long-term targets. An asymptote proposal is shown in Fig. 9, wherein integrating “electric” and “optical” service platforms into the same platform is done flexibly, fully transparent to users, and satisfies the ubiquitous nature of the NwGN (everywhere, every service, all the time).

Clearly, the main technologies applied in the NwGN are as follows.

1. Integrating telecom services in a new Integrated Multimedia System (IMS) system that can satisfy all user demands by providing multi-services on one telecom platform.

2. Applying Web 3.0 technology, accompanied with cloud computing on the servers. This application will help computing, saving, and exposing data access and searches that are safer and more flexible.

3. Increasing the computing capacity of mobile devices and wireless network popularity. Wireless technologies will involve more and more intelligent devices that connect and create the Internet of Things.

4. Developing and applying new generation transmission technologies that achieve transmission rates in petabits per second (Pbps) for the core network and more than 100Gbps for the access network. That Vietnam telecom service providers deploy widely Gigabit-capable Passive Optical Networks (GPON) and provide multi-services with large bandwidth to very many users is considered an asymptote way to the NwGN. To improve quality of service, we need to develop new generation transmission technologies, including optical transmission technology, new kinds of optical fiber, wavelength changing, optical signal reforming, optical signal quality supervising, optical switching, and optical buffers.

5. Applying intelligent wireless technology (IWT) will solve the current limitation in frequency bands. Dynamic frequency-band access technology allows IWT to work in most of the available frequency bands. In the future, this technology is ideal for telecom services which demand very high quality, such as emergency services, multimedia, broadband services, and so on.

6. Applying wireless sensor networks (WSNs) creates small and low-energy sensor devices that communicate through wireless connections. The technology of the WSN can be used in a natural environment with the task of reckoning, computing, and collecting environmental parameters to centralize processing, controlling, and so on. The WSN is presently widely applied in national defense, public security, health, transportation, the environment, agriculture, and many other fields.

7. Modernizing the core of the telecom network will
satisfy present demands and will help move towards the future network, which must support high transmission demand. The OTN, following ITU-T Recommendation G.709, G.782 [15, 16], will be the future technology, at least for the next few decades. For Vietnam, investing in the core network is presently worth an effective orientation [14, 20, 21] towards improving the core network and the access network. Integrating all kinds of transmissions, such as wired lines, wireless connections, WiMAX, etc., will serve masses of people everywhere and at any time. About the network technology, researching and applying new routing algorithms, new techniques of network resource distribution, and new anti-congestion techniques, etc., will help improve network performance.

8. Applying new “green” technology will soon specify the standards concerning the environment for all applications, such as energy savings, energy recycling, solar energy, tidal energy, and other such technologies. State policies about investing in equipment and technological projects, etc., must ensure that more and more equipment is friendly to the environment, consumes low energy, uses light materials, recycled materials, or low heat-radiating materials, and so on. That is surely a prioritized orientation towards the NwGN.

9. Applying other highly social applications must be prioritized to solve issues such as work solutions, medical services, education, bio-balancing, anti-climate change efforts, reasonable equilibration of sex, age, and characteristics of each network user, and so on.

10. Widely deploying IPv6 in telecom devices, mobile phones, and electronic equipment will help to create a very intelligent network, will reduce network address address translator (NAT) utilization to increase network speed, and will control telecom and wireless devices directly and easily. Deploying the next generation of mobile technologies, like 4G, LTE, 5G, accompanied by using IPv6 in each device, will create a ubiquitous network that can directly locate every device.

In conclusion, technologically, the NwGN covers almost all the newest technologies to orientate society towards the new vision of the NwGN, as mentioned in Section 2, to become a network that has a social nature and is friendly to the environment.

4.2.2 Asymptotic Way to the NwGN

Promoting Application Research and Development

Network development trends in the near future must best satisfy social requirements; hence, research into developing applications was, and is, the present goal. By that trend, changing network service nature is from that users must change their behavior to use information and communication, to that information and communication system must change itself to satisfy users’ demands. At the same time, the network must ensure all services are available to users everywhere at any time. That is surely the asymptotic way towards the NwGN now. With the comfort from network services, particularly with highly social services, we need a “multi-network” that can provide “multi-services” on the same infrastructure.
the targets given. The asymptotic ways proposed in Section 4.2 are very efficient ways to help the Vietnam telecom network to improve and move towards the NwGN in the future.

Therefore, with more and more expansion in the telecom market nowadays, the asymptote towards the NwGN is very necessary in order to lead, and derive profits from planning policies to satisfy social demands in the information and communication field at the present time.

5. Conclusion

The new generation network up to now is truly an efficient solution to modernizing the telecom networks of service providers in the world, in general, and in Vietnam, in particular. This modernization is one part of satisfying the current demand for information and communications, and for solving problems like lack of bandwidth, network congestion, etc. In other ways, the NwGN, at the same time, is an important base for satisfying the high demand for communications and information up to the year 2020 and beyond. The trend towards the NwGN is quite indispensable to meeting future demand, and the asymptotic way towards the NwGN is an objective reality for all service providers in the world, as well as in Vietnam.

In the scope of this paper, we only present an overview of the NwGN, the targets and the challenges in the orientation towards the NwGN in the future. The proposals in Section 4 are about targets that must be obtained to help manufacturers, service providers, and users in the world find an orientation towards the NwGN hereafter.

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