ITU-T Future Networks: A Step towards Green Computing

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***Abstract*: - In the field of telecommunications, information and communication technologies (ICTs) the United Nations specialized agency is termed as International Telecommunication Union (ITU) which is a standard. Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is identified to be responsible for studying technical, operation including tariff rates, grade of service and issuing recommendations on them with a view to standardizing telecommunications on a worldwide basis. This paper describes a review on objective and design goals of Next generation networks in general and ITU-T networks in particular, further this paper discusses the role of ITU –T in Green Computing, which is the need of tomorrow. Energy saving for Next generation networks, as recommended by ITU. As a conclusion the target date estimated is 2020 in which parts of a network are expected to evolve. Evolution and migration strategy may be employed to accommodate emerging and future network technologies.**

***Index Terms*—ITU-T, ICT, Future Network, Green Computing, ITU-T Y.3021.**

I. Introduction

There have been continuous efforts and progress regarding the research and development of future network technologies in recent years, such as network virtualization and software defined networking, automatic management, information centric networking (ICN), cloud networking, automatic management, and open connectivity. ITU-T started working on the standardization of Future network in late 2009, and it has developed some initial recommendation that lay out the essential directions for subsequent detailed work ref [1].

A future network (FN) is a network that is able to provide services, capabilities, and facilities that is difficult to be provided by the existing network technologies. A future network is either: (a) a new component network or an enhanced version of an existing one, or (b) a heterogeneous collection of new component networks or of new and existing component networks which is operated as a single network. The plural form "Future Networks" (FNs) shows that there may be more than one network that fits the definition of a Future Network. A network of type b may also include networks of type a. While some requirements for networks do not change, a number of requirements are evolving and changing and new requirements arise, causing networks and their architecture to evolve.

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For future networks, traditional requirements such as fair competition which reflect society's values remain important.

At the same time, new requirements are emerging. Sustainability and environmental issues will be of vital important considerations over the long term. New areas of applications such as Internet of Things, smart grids, and cloud computing are also emerging. Also, new implementation technologies, such as advanced silicon and optical technology, enable support of requirements that were conventionally considered unrealistic, by substantially reducing the production cost of equipments.

The basic architecture of large scale public networks is difficult to change because it contains enormous amount of resources needed to build it. Therefore, their architecture is carefully designed to be flexible enough to satisfy continually changing requirements. However, it is not known if the current networks can continue to fulfill changing requirements in the future. It is also not known whether the growing market of new application area will have the potential to fund the enormous investment required to change the networks. research communities have been working on various architectures and supporting technologies., such as network virtualization, energy saving of networks, and content-centric networks. Future networks trial services and phased deployment is estimated to fall approximately between 2015 and 2020. ITU-T Y.3001 [2] recommendation describes objectives that may differentiate FNs from existing networks, design goals that FNs should satisfy, target dates and migration issues, and technologies for achieving the design goals

II. Objectives & Design goals review

FNs are recommended to fulfill the following objectives which reflect the new requirements that are emerging:

Service awareness
Data awareness
Environmental awareness and
Social and economic awareness

FNs should provide services, without drastic increase in deployment and potential costs, whose functions are designed to be appropriate to the needs of applications and users.

The FNs architecture should be optimized to handle the enormous amount of data in a distributed environment, and should enable users to access desired data safely, easily, quickly, and accurately, irrespective of their location.

FNs should be environmentally friendly, should minimize their environmental impact such as consumption of materials and energy and reduction of greenhouse gas emissions, and should be designed and implemented so that they can be used to reduce the environmental impact of

other sectors. Considerations of social and economic issues should also be there in FNs so as to reduce the barriers to entry of the various factors involved in the network ecosystem. Development of FNs should also consider the need to reduce their lifecycle costs in order for them to be deployable and sustainable. These factors will help to universalize the services, and allow appropriate competition and an appropriate return for all actors.

FNs design goals are high-level capabilities and characteristics that should be supported by it. FNs support twelve design goals as illustrated in Figure 1 which also shows relationships between four objectives mentioned in section 2 above.

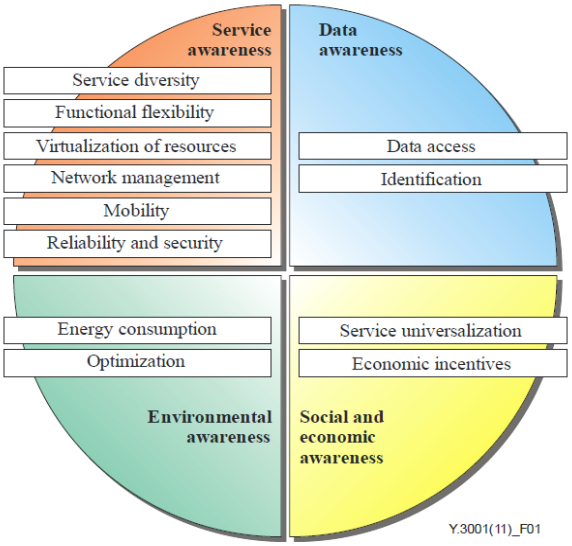

Figure-1 Four objectives and twelve design goals of future networks

The twelve design goals are:

Service diversity, Functional flexibility, Virtualization resources, Data access, Energy consumption, service universalization, Economic incentives, Network management, Mobility, Optimization, Identification, reliability & security.

FNs should support diversified services accommodating a wide variety of traffic characteristics and behaviors. They should support a huge number and wide variety of communication objects, such as sensors and terminal devices, to achieve an all-encompassing communication environment.

FNs are recommended to offer functional flexibility to support and sustain new services derived from user demands by enabling dynamic modifications of network functions in order to operate various network services that have specific demands. Current network design does not always provide sufficient flexibility.

FNs should support virtualization of resources associated with networks in order to support partitioning of resources so that a single resource could be shared concurrently among multiple virtual resources. It allows network to operate without interfering with the operation of the other virtual networks while sharing network resources among virtual networks.

FNs should be designed and implemented for optimal and efficient handling of huge amount of data. They should have mechanism for promptly retrieving data regardless of their location. Because of importance of data access, FNs should provide users with the means to access appropriate data easily and without time-consuming procedures, while providing accurate and correct data.

FNs should use device-level, equipment-level, and network-level technologies, in cooperation with each other, to improve energy efficiency, and to satisfy customers' demands, with minimum traffic. Energy saving plays an important role in reducing the environmental impact of networks.

III. GREEN COMPUTING

Sustainable Information Technology has been a mojor focus for IT organization for the past few years has been risen rapidly. The target area of first wave of sustainable IT initiatives has been on strategies to increase data centre efficiency. So power and work distribution, thermal management, product design, virtulization and cloud computing have assumed primacy in terms of both strategic and tactical focus. The second wave of sustainable IT services is nascent and much more difficult to define and implement.

IV. DISCUSSION

Green IT in Future Network

Environmental awareness is one of the basic features of future networks development which is realized via energy saving technologies. Energy saving increases benefits to the company or users, such as reduced costs of energy and temperature management for stability of machine operation. Because of widespread implementation of network equipments and the greater energy consumption required by these equipments, and also the social aspect of supporting the reduction of greenhouse gas (GHG) emissions increases the importance of these issues. To reduce the negative impact of environment, information and communication technology (ICT) is categorized into:

- "Green by ICT", and
- "Green ICT"

To reduce the environmental impact of the non-ICT sectors by using ICTs is referred to as "Green by ICT" while to reduce the environmental impact of the ICT itself, for example, electric power consumption reduction of personal computers, routers and servers. Therefore, Future networks contribution in reduction of environmental impact can be categorized as:

- "Green by Future Networks", and
- "Green Future Networks"

Future networks should be designed in such a way that it should reduce the environmental impact of other sectors. For example, design of network architecture For electric power distribution of smart grids, or ubiquitous sensor networks that monitor environmental changes of the earth are few examples of "Green by Future Networks".

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Future networks must have minimum impact on the environment. "Green by Future Networks" reduces the environmental impact of other sectors [10]. In this process, the future networks increase the volume of traffic flowing into networks and thus increase the energy consumption of the networks which then increase the environmental impact. "Green Future Networks", which means energy saving within the networks themselves, reduces the energy consumption of network facilities such as desktops, servers, routers, switches, etc.

In life-cycle management stages such as, 'production (preparation of raw materials and components for the target), manufacturing, use, and disposal/recycling', attention must be paid to reduce the energy consumption. At each stage, a variety of technologies at different levels such as device-level (electronic devices as large scale integration (LSI) and memory), equipment-level (one piece of equipment (a set of devices) such as router or switch), and network-level (equipments within the whole network (e.g., a routing protocol applied to multiple routers)) should be for energy saving within the networks

V. Conclusion

ITU-T has published four important recommendations during 2009-2012. These are: Y.3001, Y.3011, Y.3021, and Y.3031 representing the first standard descriptions of future networks. In addition to connectivity services, FNs are characterized by four objectives and twelve design goals. These design goals are advanced capabilities, features, and new network services that are needed together to realize FNs. It is believed that these recommendations will provide a sound foundation and appropriate guidance for subsequent FNs' realization, standardization, research, and development. In these recommendations, description of FNs is to meet assumption that trial services and phased deployment of future networks supporting the described objectives and design goals falls approximately between 2015 and 2020. Tablets and PCs used by peoples are potentially harmful. Such evolution and migration scenarios are topics for further studies.

REFERENCES

[1] D. Matsubara et al., "Towards Future Networks: A Viewpoint from ITU-T", IEEE Communication Magazine, March 2013.
[2] ITU-T F.851] Recommendation ITU-T F.851 (1995), *Universal Personal Telecommunication (UPT) – Service description (service set 1)*.
[3] [ITU-T Y.2001] Recommendation ITU-T Y.2001 (2004), *General overview of NGN*.
[4] [ITU-T Y.2019] Recommendation (2010), *Content delivery functional architecture in NGN*.
[5] [ITU-T Y.2091] Recommendation ITU-T Y.2091 (2008), *Terms and definitions for Next Generation Networks*.
[6] [ITU-T Y.2205] Recommendation ITU-T Y.2205 (2011), *Next Generation Networks –Emergency telecommunications – Technical considerations*.
[7] Aravind, D., & Christmann, P. (2008). Institutional and resource-based determinants of substantive implementation of ISO 14001. Paper presented at the Academy of Management Conference, Anaheim, CA.
[8] Argyris, C., & Schon, D. A. (1978). Organizational learning. Reading, MA: Addison-Wesley.
[9] Ashforth, B. E., & Gibbs, B. W. (1990). The double-edge of organizational legitimation. Organization Science, 1, 177−194.
[10] Austin, J., Hatfield, D. B., Grindle, A. C., & Bailey, J. S. (1993). Increasing recycling in office environments: The effects of specific, informative cues. Journal of Applied Behavior Analysis, 26, 247−253.
[11] Azzone, G., & Bertel, U. (1994). Exploiting green strategies for competitive advantage. Long Range Planning, 27(6), 69−81.
[12] Bandura, A. (1986). Social foundations of thought and action. Englewood Cliffs, NJ: Prentice Hall.
[13] C. Cormio, and K. R. Chowdhury, "A survey on MAC protocols for cognitive radio networks," Ad Hoc Networks, vol. 7, pp. 1315-1329, Sep. 2009.
[14] H. Adam, W. Elmenreich, C. Bettstetter, and S. M. Senouci, "CoRe-MAC: a MAC-protocol for cooperative relaying in wireless networks," Proc. IEEE Globecom09, pp. 1-6, Dec. 2009.
[15] L. Ding, T. Melodia, S. N. Batalama, and J. D. Matyjas, "Distributed Routing, Relay Selection, and Spectrum Allocation in Cognitive and Cooperative Ad Hoc Networks," Proc. IEEE SECON'10, pp.1-9, 2010
[16] J. Alonso-Zrate, E. Kartsakli, C. Verikoukis, and L. Alonso, "Persistent RCSMA: A MAC Protocol for a Distributed Cooperative ARQ Scheme in Wireless Networks," EURASIP Journal on Advances in Signal Processing, vol. 2008, pp. 1-14, 2008.

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Brief description of changes on 2014/9/10:

Add the second author, Abdallah Ahmed Hamdan.

Review of Objectives and design goals of Future Networks are consolidated in section II. A new section IV is added on discussion of Green IT in Future networks. References are modified and Author biography is added in the end.