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ITU-T Standardization for Energy Saving using NGN and Connected Objects (Invited)

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This paper introduces several activities for standardization in the support of ubiquitous networking and energy saving in the next generation networks (NGN). For energy saving, we explain basic concepts of ubiquitous networking and present impact of services combining information technology (IT) and other industries using connected objects. Based on requirements for energy saving, we illustrate several examples such as smart home/building and intelligent transport system (ITS). Finally, we emphasize the necessity of developing valuable standards in collaboration with other standardization bodies for energy saving using NGN and connected objects.

1. Introduction

Broadly speaking the phrase next generation networks (NGN) refers to the move from circuit switched to packet based networks. It will mean reduced costs for service providers who will in turn be able to offer a richer variety of services. Convergence is a key word in the NGN field. Built upon the Internet protocol (IP), the convergence between networks and/or technologies such as public switched telephone network (PSTN), digital subscriber line (DSL), cable television (CATV), wireless local area network (WLAN) and mobile technologies is a task that many believe is impossible without the development of global standards. ITU-T¹ Study Group (SG) 13 leads ITU's work on standards for NGN [1].

As energy saving is quite important for efficient and comfortable life, there are many relevant activities in information and communications technology (ICT) domain. Energy issues such as energy harvesting and low-power chipsets are central to the ubiquitous networking environment of so-called "the Internet of things (IoT)". Energy generation devices coupling energy transmission methods or energy harvesting using energy conversion will be the key factors for implementing autonomous wireless smart objects. For this, networking capabilities will be key roles for energy saving.

In ubiquitous networking environment, everything is becoming connected. Therefore, a network has evolved from primarily a source of information to the platform for all types of applications. Smart and connected communities using "connecting to anything" capability of ubiquitous networking in NGN will be popular. Therefore, one of core applications for interdisciplinary fusion services, we need to develop

¹ ITU-T: International Telecommunication Union Telecommunication Standardization Sector

solutions for energy saving using smart objects through combining information technology (IT) and other technologies.

In this paper, we introduce several activities for standardization in the support of ubiquitous networking and energy saving in NGN in Section 2. For energy saving, we explain basic concepts of ubiquitous networking and present impact of services combining IT and other industries using connected objects in Section 3. Based on requirements for energy saving, we illustrate several examples such as smart home/building and intelligent transport system (ITS) in Section 4. Finally, we emphasize the necessity of developing valuable standards in collaboration with other standardization bodies for energy saving using NGN and connected objects.

2. Standardization for Enhanced NGN in ITU-T

2.1 SG13 and NGN-GSI activities for NGN standards

ITU-T SG13 is responsible for studies relating to the architecture, evolution and convergence of NGN including frameworks and functional architectures, signalling requirements for NGN, NGN project management, coordination across SGs and release planning, implementation scenarios and deployment models, network and service capabilities, interoperability, impact of Internet protocol version 6 (IPv6), NGN mobility and network convergence, and public data network aspects.

ITU-T NGN-global standards initiative (NGN-GSI) is an effort which encompasses all NGN work across ITU-T SGs by co-located meetings of concerned SGs and rapporteur groups meet together to jointly progress the work under the auspices of NGN-GSI. Over the last few years, the market drive for NGN standards has firmed up and a number of operators have announced implementation plans for the transition to NGN. Study topics of NGN-GSI are related to the development of architectures, interface specifications, and implementation guidelines in the form of ITU-T standards (recommendations) for the realization of NGN as follows:

- Evolution of networks to NGN to allow for the continuation of, and interoperability with, existing networks while in parallel enabling the implementation of new capabilities.
- QoS for 'subjective user satisfaction'.
- Interoperability between different systems and networks which will involve a broad series of protocols (including various profiles) at both service and network levels.
- Security in the aspect of NGN architecture, operational policy, capabilities and protocols.
- Generalized mobility to communicate and to access services irrespective of change of location or technical environment.
- Service capabilities and architecture for the telecommunication service capabilities and the suitable architecture(s) to support different business models and seamless communication.

2.2 Work scope for enhanced NGN

NGN is now being positioned as the core of today's telecommunication not only for standards purposes but also for business development purposes. Consequently, SG13 is considering the following three dimensions as objectives:

- Scope: extend NGN requirements, functions and capabilities covering future ubiquitous networking environments (e.g., ad-hoc networks including radio frequency identifications (RFIDs) and sensors), use of IPv6, home network and service technology, new and converged transport technology, and etc;
- Depth: develop detailed technology to implement networks and services such as detailed functional requirements to support control protocols including both service and transport control, service and application support platforms supporting convergences with relevant protocols aspects, OAM&P² mechanisms, media processing including codec(s), and etc;
- Packaging: make various packages to show and guide utilization of NGN to support various services and application into actual businesses, including migration to NGN and interworking of NGN, service scenarios (e.g., Voice/Multimedia/Video/IPTV over NGN), Web based services using NGN, 3rd party applications, u-health, e-learning, and etc.

In order to maximize the synergy for the experts and minimize the alignment efforts among various study groups, the work for the SG13 is grouped according to the following key areas of competence:

- Communication networks aspects: study for requirements, functional architectures and their capabilities, according to the layered approach such as transport (access and core), transport control, service control, and service/application support functions;
- Content distribution networks aspects: study for the requirements, functions and mechanisms to support distribution of contents as requested by end user. This will include capabilities to support content finding/metadata, content distribution, rights management, and media coding;
- Ad hoc networks aspects: study for the requirements, functions and mechanisms to support configuration of ad-hoc networks used for identifying service discovery and activation, and context description/distribution including peer-to-peer networking;
- Common functions aspects: study for functions and relevant capabilities to support identifier management (e.g., numbering, naming, and addressing), identity management (e.g., security frameworks and protect user data), charging and billing, and management of devices.

2.3 ITU-T activities for energy saving

The ITU-T TSAG³ launched a work program on ICTs and climate change. This work aims at limiting and ultimately reducing, green house gas (GHG) emissions. It also seeks to foster sustainable development, promote energy efficiency in the

² OAM&P: Operation, Administration, Maintenance and Provisioning

³ TSAG: Telecommunication Standardization Advisory Group

development of recommendations and make users and operators aware of the possibilities of climate change mitigation through the use of ICTs. Reducing energy waste and increasing power efficiency is the optimal way to reduce CO₂ emissions and it also presents great advantages to telecom operators and service providers in terms of cost savings. The followings show key ITU-T activities to address energy saving including climate change [2].

- Coordination of the orbital and frequency resources for satellites which play a vital role in gathering data on climate change, such as earth-observation and global climate observing systems (GCOS).
- Standardization work on reducing power requirements of telecommunication equipment, including terminal devices and networking equipment that will have the additional environmental benefit of reducing the production of greenhouse gases and global warming. Standards for NGN, being developed at ITU, should bring about a 40 percent saving in energy consumption compared with today's telecommunication networks.
- High-level policy review and guidelines to help developing countries take full advantage of ICT applications for environmental management and sustainable development.
- Two specific technologies under the standardization spotlight (i.e., RFID and ubiquitous sensor networks (USNs)) can help reduce consumption of fossil fuels, by using motion sensors that switch on lights only when necessary or by automatically adjusting heating requirements.
- Significant work on the use of ICT for disaster preparedness (monitoring, detection and prediction).

3. Ubiquitous Networking using NGN and Connected Objects

3.1 The concept of ubiquitous networking

ITU-T defined that the term “ubiquitous networking” is the ability for persons and/or devices to access services and communicate while minimizing technical restrictions regarding where, when and how these services are accessed, in the context of the service(s) subscribed to. This term is used for naming the networking capabilities which are needed to provide the support of various classes of applications/services which require “Any Services, Any Time, Any Where and Any Objects” type of operation [3].

One of the ultimate objectives of ubiquitous networking is to meet the challenge of seamless communications of “anything” (e.g. persons and objects). Ubiquitous networking will have to encompass the following:

- Ubiquitous connectivity allowing for whenever, whoever, wherever, whatever types of communications;
- Pervasive reality for effective interface to provide connectable real world environments;
- Ambient intelligence allowing for innovative communications and providing increased value creation.

Ubiquitous networking supports three types of communications:

- Person-to-Person Communication: persons communicate with each other using attached devices (e.g. mobile phone, PC);
- Person-to-Object Communication: persons communicate with a device in order to get specific information (e.g., IPTV content, file transfer);
- Object-to-Object Communication: an object delivers information (e.g. sensor related information) to another object with or without involvement of persons.

Ubiquitous networking aims to provide seamless communications between persons, between objects as well as between persons and objects while they move from one location to another.

3.2 Connected Objects and their applications

The object means that the user or other entity which is connected to the network. It includes almost everything around us such as remote monitoring and information device/machine/content, etc.

There are many different kinds of devices connecting to the network supported for ubiquitous networking in NGN. RFID tag, sensors, smart cards, medical devices, navigation devices, vehicles as well as the existing personal devices such as PC, smart phone, etc., are examples of these. We consider that the end points that are not always humans but may be objects such as devices/machines, and then expanding to small objects and parts of objects.

Until now, communication networks have been mainly supported the evolution of information processing and service capabilities within IT industries. However, the capabilities of networks using connected objects should be impacted to other industries such as medical industry, education industry, finance industry, transportation/distribution industry, etc., resulting new requirements for medical education networks and services taking into consideration of IT technologies. One of key roles of connected objects is solution for interdisciplinary fusion services combining IT and other technologies. These are also quite related to energy saving aspects.

For energy saving using connected objects benefiting from ubiquitous networking, required capabilities include energy consumption monitoring and control, intelligent power consumption monitoring application, Web-based information processing, personalized service creation, secure access through identity-based user management and IP connectivity, etc.

4. **Examples of energy saving using NGN and connected objects**

Figure 1 shows examples of energy saving using smart objects. For home/building environment, objects such as energy saving system, smart meter, and home automation controller are used for energy management. For vehicle environment, objects such as navigation, devices for safety are used for energy saving.

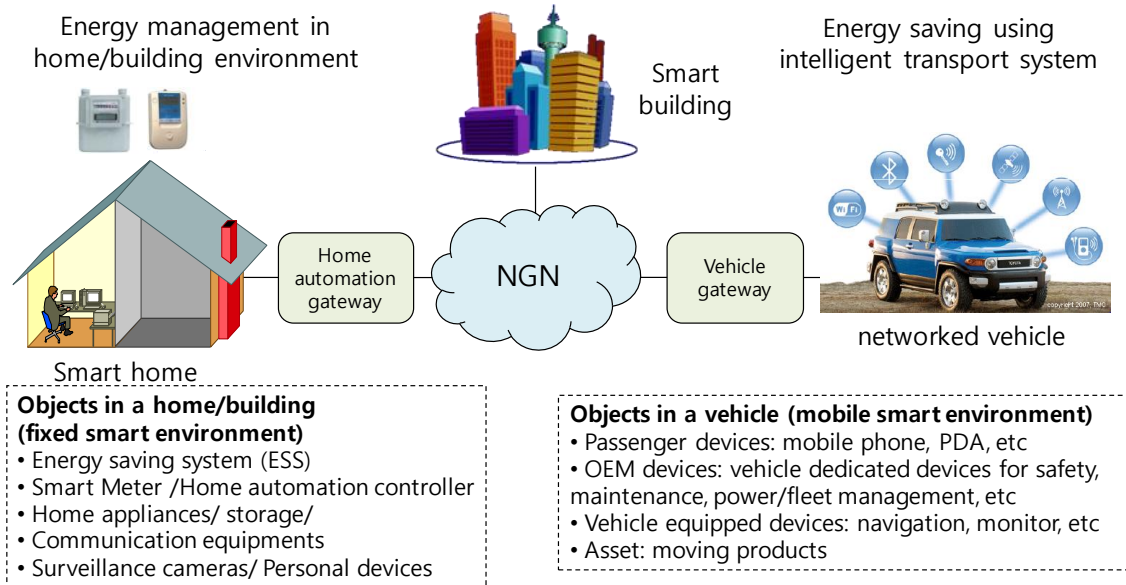


Figure 1: Examples of energy saving using smart objects

4.1 Smart home/building [4]

The term “mart buildings” describes a suite of technologies used to make the design, construction and operation of buildings more efficient, applicable to both existing and new-build properties. Smart buildings include building management systems (BMS) that run heating and cooling systems according to occupants’ needs or software that switches off all PCs and monitors after everyone has gone home. BMS data are used to identify additional opportunities for efficiency improvements. A host of BMSs already exist and as ICT applications become more sophisticated, the range of BMS functions will expand.

Building system engineering supported by intelligent and networked room and building controllers (lighting, sun protection, heating, ventilation and air conditioning as well as the other building engineering systems) contribute significantly to conservative and requirement-based energy use.

Various concepts and approaches are possible in the optimization of energy efficiency in buildings. The use of intelligent building control provides a proven and interesting alternative or addition that is clearly set apart by its convincing cost-benefit ratio.

4.2 Intelligent transport system (ITS)

Automotive transport represents one of the main sources of GHG emissions, but the generalized availability of ultra-high-speed broadband access, with ubiquitous provision of services associated with NGN, would enable multiple tasks to be achieved simultaneously with minimum power consumption.

ICTs can be applied to transport through the development of ITS. Although the main focus of ITS is on the safety, management and efficiency of transport systems, ITS

can also be used to reduce their environmental impact. The followings are examples for energy saving using ITS:

- Parking guidance systems can lead motorists to the most appropriate parking space, and thereby reduce engine time;
- Global positioning system (GPS) use for navigation or vehicle dispatch can reduce journey time;
- Road pricing schemes, can encourage greater use of public transport and reduce congestion, thereby reducing journey times.

Key issues of ICTs and climate change using ITS include cars as environmental sensors, alternative route/transport planning, ICT-enabled energy efficiency, car-to-grid energy transfer.

5. Concluding Remark and Future Direction for Standardization

This paper has presented the issues for standardization to support ubiquitous networking capabilities in an enhanced NGN which is under development by ITU-T SG13. We have provided the basic concept of ubiquitous networking based on the NGN. In addition, we have clearly identified key requirements and examples for energy saving using NGN and connected objects. We hope that our proposals will provide some key inputs for future standardization efforts.

As future work, we need to focus on objects-to-objects communications for energy saving in ubiquitous networking environment and energy saving aspects. Key technologies include smart technologies to use ICTs for saving energy and solutions for location tracking, sensing, surveillance and management capabilities to improve energy efficiency. From NGN perspectives, user-centric services and customizable and efficient service provision using NGN capabilities according to applications/use cases are important. For this it would be helpful if the relevant standards efforts for energy saving using NGN and connected objects. This can only be achieved with close collaboration among related SDOs such as ITU-T, IETF⁴, ISO/IEC⁵, etc.

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⁴ IETF: Internet Engineering Task Force

⁵ ISO/IEC: International Organization for Standardization/International Electrotechnical Commission