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Title: Smart Grids and Cloud Computing

SUMMARY: This Report addresses the issues of cloud computing and smart grids in the context of future work in the ITU-T.

ACTION REQUIRED: TSAG is invited:

(1) to note the report and

(2) to request relevant Study Groups to consider possible future work in these areas

I. BACKGROUND

Smart grids and cloud computing are two distinct topics, both of which are of great importance in the current standardization environment. Smart grids represent one of the most promising sectors for using ICTs to reduce global greenhouse emission (GHGs) as part of the effort to combat global warming and many ICT companies have already actively engaged in this field. Cloud computing is a growing trend and poses new challenges for networks, services and applications.

Smart grids and cloud computing were two important topics that were discussed at the CTO Group meeting on 6 October and figured in the communiqué agreed to by CTOs and in the Action Plan adopted by the Group. In pertinent part, on these two topics the CTO Group Communiqué states with respect to ITU-T:

> "Among the other ICT standardization hot topics discussed in the CTO Meeting were cloud computing and smart grids. In both these areas, ITU-T should concentrate efforts on the network capabilities to support these developments."

Each of these topics is discussed separately in the following sections. This Report has benefited from comments from the relevant Study Group Chairmen.

II. CLOUD COMPUTING

Cloud Computing was examined extensively in Technology Watch Report No. 9 issued in March 2009 (http://www.itu.int/oth/T2301000009/en). "The spread of high-speed broadband networks and the continual increase in computing power have changed how society manages information and

information services. Geographically distributed resources, such as data banks and supercomputers, are interconnected and can be exploited by users around the world as single, unified resource. To a growing extent, repetitive or resource-intensive information technology tasks can be outsourced to service providers, and a new paradigm is emerging in which computing is offered as a utility by third parties. It is no longer necessary for companies to contain their computer work in house, as not only data can be processed and software stored remotely on a "cloud", but large networks of remote computers can form a "grid" that amounts to considerable power."

Many aspects of cloud computing will require standardization. Standardized solutions for automation, monitoring, provisioning and configuration of cloud and grid applications would ensure interoperability. Portability is also a concern, as users may want to employ infrastructure and services from different providers at the same time. Global standards and interfaces would allow them to do so. On the provider side, there could be an interest in standards for distributed network management, memory management and load balancing, identity management and security, and standards that allow for scalability of infrastructure. A critical matte is to develop a common understanding or definition of cloud computing, which could be studied by ITU-T.

As described in the TECHWATCH Report, the ITU-T has approved a number of Recommendations that indirectly impact on distributed computing. These concern technical aspects, for instance the work on multimedia coding in Study Group 16, on television applications in SG-9 and on telecommunication security in Study Group 17, as well as operational aspects, accounting principles and QoS, treated in Study Groups 2, 3 and 12.

ITU-T Study Groups 13 and 15 have liaisons with the Optical Internetworking Forum (OIF), which provides interoperability agreements (IAs) that standardize interfaces for the underlying communication infrastructure to enable the resources to be dynamically interconnected.

ITU-T Recommendations of the E-Series ("Overall network operation, telephone service, service operation and human factors") address some of these points and provide, *inter alia*, definitions related to QoS (E.800) and propose a framework of a Service Level Agreement (E.860).

Recommendations in the ITU-T M.3000 series describe the Telecommunication Management Network protocol model, which provides a framework for achieving interconnectivity and communication across heterogeneous operation systems and telecommunication networks. The TMF multi-technology network management solution is referenced in ITU-T Recommendation M.3170.0 ff.

Relevant work underway in other standards bodies on cloud computing includes such areas as security, servers, storage and applications (e.g. Distributed Management Task Force, Cloud Security Alliance, Open Grid Forum and Storage Network Industry Association (more fully described in the TechWatch Report) and there is thus an opportunity for dialogue with these and other groups.

The CTO Group meeting indicated that future ITU work in this area should concentrate on areas of network needs and management, interface of networks, QoS, and other indentified gaps and recognize need to move quickly and avoid duplication with other standards initiatives. The CTO Group Action Plan contains 2 items on cloud computing:

Cloud Computing		**TSB** tsbspd@itu.int
26	Establish Task Force to study cloud computing and make proposals to develop a focused list of needed standards or principles for possible action within ITU-T, including specifications to enable cloud service migration. Focus on areas of network needs and management, interface of networks, QoS, and other indentified gaps and recognize need to move quickly and avoid duplication with other standards initiatives.	
27	Request that SG13 develop and provide a list of standards or principles for possible action within ITU-T on cloud computing, including specifications to enable cloud service migration.	TSB/ITU-T

Proposed Action

To facilitate a comprehensive approach to cloud computing, including interoperability and reliability, consideration should be given to the optimal allocation of this work among ITU-T Study groups and the establishment of appropriate modalities to coordinate the work.

III. SMART GRIDS

Smart grids have become an important issue, as they represent a key opportunity for using ICTs to reduce global greenhouse gas (GHG) emissions in another sector. For example, coal use, primarily for generation of electricity, now accounts for about 20 percent of global GHG emission. The GeSI Report estimated that smart grids represent an abatement potential of 2.03 Gt of CO2e by 2020.

A Smart Grid is an intelligent networked grid based on a set of software and hardware tools that enable electricity generators to route power more effectively, including advanced grid management systems, demand management systems and reduced transmission and distribution losses (T&D). Smart grids mean adding ICT capability to the electric grid, such as sensors and digital meters and improving communications among utility operators and components of the grid, including power lines, appliances and customer meters. A key component is smart meters, often in the home or business, that are able to:

- Measure consumption data and send this information to approved external third parties.
- Send and receive commands from these third parties.
- act on these commands to adjust the operating regime of equipment or appliances linked to the Home Area Network.

A major challenge for utility firms deploying smart meters is collecting and managing the massive volume of data generated by these devices.

A smart network would also be able to

- import and export electricity generated via micro generation.
- monitor the load at any moment to be able to recommend export or import behaviour to the end consumer.
- exert control at all levels of utility production and transmission infrastructure, allowing real time adjustment to market demand and supply.

Smart grids can also be useful for the efficient use of plug-in hybrid cars. They could facilitate the integration of renewable energy sources in power generation, e.g. by balancing demand from electric car charging.

Smart grids represent an increasing commercial opportunity. Many governments have earmarked parts of their stimulus packages for smart grids. In the US, venture capitalists have invested more than $1bn into smart grid start-ups and several major ICT companies (e.g. Cisco, Siemens and IBM) already are offering products and applications to modernize grids. Berg Insight says the European smart metering market will experience compound annual growth of 20% between 2008 and 2013, reaching €2.3 billion at the end of this period. Strategy Analytics believes there will be around 88 million smart meters installed across Europe by 2014.

A recent article in the Economist (10 Oct. 2009) postulates three different strata of technologies in smart grids: (1) advanced metering infrastructure (AMI), (2) technology needs to manage the usage data, and (3) the home area network (HAN) and notes that standards have yet to emerge for many of the products that will be needed.

SG13 is already addressing some elements of smart girds as well as SG16 work on home gateways. SG17 established two correspondence groups on security aspects for smart grids and cloud computing. A joint workshop with IEEE on smart grids is being planned.

Standards work that already has been launched in other SDOS includes:

- HomeGrid Forum has announced liaison agreements with Demand Response Smart Grid (DRSG) Coalition and Z-Wave Alliance. Together they will link efforts to promote G.hn and ensure upcoming G.hn-based products and devices are compliant with the requirements for deployment in Smart Grid, home energy management, and home automation applications.
- A number of leading technology companies have come together to form the Smart Energy Alliance [http://www.smart-energy-alliance.com/] in an attempt to maximise the commercial opportunities created by this convergence of information technology, communications and energy systems.
- The ZigBee alliance is prominent in standards for in-the-home wireless links [http://www.electronicsweekly.com/Articles/2009/05/29/46180/zigbee-to-be-wireless-standard-for-smart-meters-in-europe.htm]
- IEEE is pursing standards work in several areas related to smart grids as well as a smart grid focus.
- IETF has a Working Group on ROLL (Routing over Low Power and Loss Networks)
- The EC has issued a mandate (m/441) for the standardization of Smart Metering functionalities and communication for usage in Europe for electricity, gas, heat and water applications .The three ESOs (CEN, CENELEC and ETSI) are responding to the EC mandate
- Interface standards are the subject of collaboration between the European Telecommunications Standards Institute (ETSI) and the European Smart Metering Industry Group (ESMIG), which are looking at the various communications technologies proposed for use with smart metering systems [http://www.metering.com/node/15292], including wireless short-range communications, mobile communications and communications over wireless sensors networks.

Following a proposal from Korean Telecom, the CTO Group meeting agreed to the following action item:

Smart Grids		**KT**
28	ITU-T to act as leader of global commitment to standardize smart grid development standards to smooth process to define boundaries for business models regarding smart grids and ICTs. Consider appropriate steps to identify standardization needs for smart grids and initiate ITU-T standardization activities. Cooperate with other industry sectors and stakeholders to avoid duplication and to move quickly.	TSB/ITU-T

Proposed Action

To facilitate a comprehensive approach to smart grids; SGs 5, 13 and 15 should be requested to consider the optimal allocation of this work among ITU-T Study groups and the establishment of appropriate modalities to coordinate that work.

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