Standardization of Automation Technology for Network Slice Management by ETSI Zero Touch Network and Service Management Industry Specification Group (ZSM ISG)

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Abstract

The European Telecommunications Standards Institute established a new Industry Specification Group (ISG) on Zero touch network and Service Management (ZSM) that is working to produce a set of technical specifications on fully automated network and service management with, ideally, zero human intervention. This article describes the preparation and outcome of the recent ZSM ISG meetings.

Keywords: ZSM, network slice, ETSI

1. Introduction

The new concept called Zero touch network and Service Management (ZSM) is gaining attention from industry experts in the field of network operation. This is the vision that aims to realize fully automated network operation with ideally zero human intervention, in contrast to the conventional network operation requiring intensive human effort. The ZSM standardization is motivated by several underlying industry trends. For example, introduction of new network services is delayed because of the human involvement required in conventional network operation. New features of network services such as network slicing and edge computing will introduce additional complexities to network operation. Furthermore, maintaining the current level and number of network engineers is expected to be increasingly difficult due to demographic changes, particularly in developed countries such as Japan.

However, an unprecedented level of automation will become possible thanks to the development of new technologies such as network functions virtualization (NFV) and artificial intelligence. In view of these trends happening in the industry, the vision of ZSM has been discussed among members of the industry, who agreed to request the European Telecommunications Standards Institute (ETSI) to establish a new Industry Specification Group (ISG) to discuss this emerging subject.

2. Preparation for the new ISG

Preparation work for the new ISG on ZSM started in the spring of 2017. Employees from Deutsche Telekom, Ericsson, Hewlett-Packard Enterprise, Huawei, IBM, Intel, NEC, Nokia, NTT, NTT DOCOMO, Sprint, Telefonica, Viavi Solutions, and ZTE volunteered their time in this activity. Mr. Klaus Martiny of Deutsche Telekom led this work. The proposal

to establish the new ISG was completed in November 2017 and approved by the ETSI Board.

In parallel with this, employees of telecom operators volunteered to produce the whitepaper that describes the motivation, industry trends, the necessity of standardization, and priority items of ZSM, which is available on the ETSI website [1]. ZSM is targeted for 5G (5th-generation wireless systems), particularly in network slice deployment. NTT has contributed to making this one of the directions of ZSM ISG.

3. Discussion at ZSM meetings

The discussion topics and outcomes of the meetings held by this working group are described in this section.

3.1 Kick-off meeting

The kick-off meeting of ETSI ZSM ISG was held at the ETSI headquarters in Sophia-Antipolis, France, from January 10 to 12, 2018. This was only one month after the official establishment of the ISG. Joining the kick-off meeting were 42 experts from 23 companies around the world, and 28 contributions from members were submitted. These contributions introduced the ideas of automation of network operation as well as proposals on the work methods of the ISG.

The first task of the kick-off meeting was to elect the ISG Chair and Vice-Chairs. There was a consensus among the participants that Mr. Martiny Klaus was the right person to lead this ISG because of the astute and effective leadership he demonstrated during the preparation work. Thus, Mr. Klaus was elected as Chair of the ISG. There were three candidates for two Vice-Chair positions, and thus an election was carried out. Voting rights in the election were limited to the Founding Members, which are the companies listed as supporting companies, including NTT, in the proposal of the establishment of the ISG. This privileged status given to the Founding Members enabled NTT to push its idea highlighting network slicing as an important subject of the ISG.

In this election, NTT contacted the three candidates and asked them to support the network slice proposal. All the candidates showed their support for the proposal from NTT. This is a good example that early involvement is critical for gaining influence in standardization work. The election was held, and Mr. Toche Christian of Huawei France and Ms. Sprecher Nurit of Nokia were elected as Vice-Chairs of ISG.

Most of the meeting was spent on brainstorming discussions on key concepts of ZSM. In the preparation work, the experts had already reached a common understanding on the objective of ZSM standardization as described in the whitepaper. However, even among such experts, there were still various opinions on the details of ZSM such as, for example, candidate technologies, likely use cases, and the relationship with other technologies. Even a formal definition of ZSM was heavily debated by the experts.

Furthermore, there were newcomers who were not involved in the preparation work but who joined after the ISG was officially established. Some of these experts are not regular participants in telecommunication standardization efforts but work in other industries such as the computer industry and have different backgrounds. This was a good exercise to get to know each other and create a constructive atmosphere.

ZSM ISG established the Network Operator Council (NOC), for which participation is limited to network operators. NOC is an advisory group expected to provide recommendations to the ZSM ISG from the viewpoint of network operators, although it has no binding power on the outcomes of the ZSM ISG. In the NOC meeting held as part of the ZSM ISG kick-off meeting, Dr. Khan Ashiq was elected as NOC Chair, and Dr. Manning Serge was elected as NOC Vice-Chair. The telecom operators in the NOC meeting exchanged their views and expectations of ZSM ISG.

At the end of the meeting, the Work Items (**Table 1**) were approved based on the discussions during this kick-off meeting. Network slice was identified as an important subject in ZSM; therefore, several Work Items refer to this issue. A study on automation technology was also included in the Work Items. Standardization work usually starts with requirements followed by architecture. The ISG follows this format, and these items are given high priority. ISGs in ETSI produce two types of deliverables, Group Specifications (GSs) and Group Reports (GRs). A GS is a normative document that defines the technical features of the system being discussed using binding terms such as “shall,” “should,” and “may.” A GR is an informative document that gives useful information about the system.

3.2 Second meeting

The second meeting was held at the Nokia Training Center near Helsinki, Finland, from March 13 to 15, 2018. There were 45 experts from 26 companies participating, and 35 contributions with technical

Table 1. Work Items of ZSM-ISG (as of March 2018).

Work Item	GS/GR	Title	Rapporteur	Timing	Remark
ZSM001	GS	Use Cases and Requirements	Michael Klotz (Deutsche Telekom)	Nov. 2018	
ZSM002	GS	Reference Architecture	Uwe Rauschenbach (Nokia)	Sept. 2018	
ZSM003	GS	End to End Management and Orchestration of Network Slicing	Lan Zou (Huawei)	Nov. 2018	Discussion started in May 2018
ZSM004	GR	Landscape	Jinhua Wu (ZTE)	Nov. 2018	
ZSM005	GR	Means of Automation	Andreas Krichel (Hewlett-Packard Enterprise)	June 2018	
ZSM006	GS	Proof of Concept Framework	Klaus Martiny (Deutsche Telekom)	Apr. 2018	Approved to start at the second meeting

GR: Group Report
GS: Group Specification

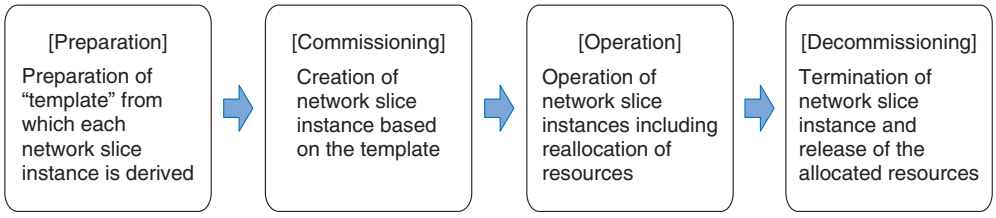

Fig. 1. Lifecycle management of network slice.

proposals were submitted. Among them, 18 contributions addressed scenarios and requirements, which were major topics at this meeting.

NTT submitted two contributions on network slice: lifecycle management of network slice, and isolation management. The basic concept of lifecycle management of network slice is defined in 3GPP (3rd Generation Partnership Project), a standards developing organization for mobile communications systems. As shown in **Fig. 1**, this concept consists of four phases: preparation, in which a template is prepared to be utilized to make network slice instances; commissioning, in which a network slice instance is produced based on the template; operation, in which the slice customer operates its own network slice instances including reallocation of resources; and decommissioning, in which the network slice instance is terminated, and allocated resources are released.

NTT explained that all phases of lifecycle management of a network slice require complicated operations such as finding relevant resources, reserving the needed amount of resources, and reallocating unused resources. Although there was a general understanding on the use of ZSM in slice management among the participants, the NTT contribution presented a clear rationale with detailed explanations. The proposal was accepted with minor updates based on the constructive discussion.

Isolation is a key characteristic of network slice and refers to the independence between network slice instances. However, there has been no agreed formal definition, and confusion has occasionally occurred in standardization discussions. The term *isolation* has been used to describe the situation where no interference occurs between radio or optical signals in the field of radio communications and optical transport. In the initial stage of discussion of network slice, a suggestion was made to apply this well-established definition of isolation. However, ensuring complete isolation, which is without any interference between network slice instances, is too difficult to achieve due to the characteristics of packet-based networks.

In view of this point, NTT proposed a new concept of network slice isolation that is more realistic if ZSM can successfully achieve certain capabilities. The proposed network slice isolation is the situation where negative impacts on network slice instances from other overloaded network slice instances are limited within the permissible level according to the requirements of the slice customer and its application

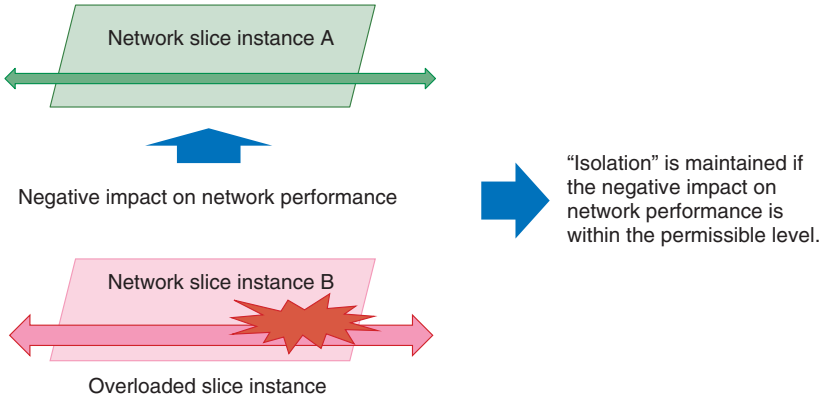

Fig. 2. Concept of isolation of network slice instances.

(**Fig. 2**).

This new concept drew attention from the participants and initiated some discussions. One of the discussions focused on how to handle a shared resource such as PON (passive optical network) or CATV (cable television) in the context of network slice isolation. In fact, the issue of resources shared among different slice customers is one of the challenges in network slice management, and substantial complexities are involved. NTT explained that ZSM should target this challenge, and the proposed approach was the starting point of this discussion.

Besides the NTT contributions, there were many contributions that addressed network slice from different viewpoints. The momentum for network slice discussion therefore increased during this meeting.

The term *ZSM* was used in the ZSM ISG as well as in the preparation work without a clear definition. The lack of a formal definition caused confusion during the discussion, and the meeting was therefore suspended so the term could be clarified. To avoid any further delays, the use of the "ZSM framework" as the formal expression for the technology to be discussed in the ISG was agreed to in the second meeting. The NOC played an important role in establishing this formal definition of ZSM.

The architecture of ZSM will illustrate how the entire ZSM system is divided into sub-level components and will indicate functions within the system and interworking with external functions/components. The architecture will be discussed after a set of scenarios and requirements are identified. The participants in the second meeting discussed the architecture principles that will guide how the architecture is illustrated. The concepts of modularity, extensibility, scalability, model-driven, open interface, closed loop management automation, security, authentication, and authorization were discussed and agreed.

The proof of concept (POC) is increasingly being recognized as an important step in standardization efforts. ZSM ISG is also undertaking the standardization of POCs to promote further standardization activity and to encourage implementation of the produced specifications. The guidelines and general procedure of POCs were discussed in the second meeting. A POC in ZSM is expected to follow current best practices such as having a POC team consisting of more than two vendors and one telecom operator, as already established in NFV and multi-access edge computing.

4. Future plan

Subsequent meetings have been regularly held via computer since the second meeting. The meeting frequency was reduced from weekly to every two weeks, but the discussions have been so active that some contributions have had to be carried over to the next discussion due to a lack of time.

The third meeting was held in Shenzhen, China, in June 2018, and the fourth meeting will be held in Kansas in the United States in October 2018. The current Work Items will be concluded by the end of this year. At that time, ZSM ISG will reveal how ZSM will achieve automation of network operation and how this technology will help the business operations of telecom operators.

Reference

[1] Zero-touch Network and Service Management – Introductory White Paper,
https://portal.etsi.org/TBSiteMap/ZSM/OperatorWhitePaper

Trademark notes

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He received a B.E. and M.E. in applied physics from Tohoku University, Miyagi, in 1992 and 1994. He joined NTT Basic Research Laboratories in 1994. He has been researching and developing cable television systems, Internet protocol television (IPTV), and machine-to-machine technology. He has been engaged in standardization work for IPTV in the International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) as a member of the IPTV Focus Group and Global Standards Initiative since 2006. He has also served as Rapporteur of Question 11 of ITU-T Study Group (SG)9, Questions 5 and 25 of ITU-T SG13, and Question 21 of ITU-T SG16. He has been a Vice-Chair of ITU-T SG13 since 2013. He is a member of the Institute of Electronics, Information and Communication Engineers.