HORIZON2020 FRAMEWORK PROGRAMME

TOPIC EUK-03-2016

"Federated Cloud resource brokerage for mobile cloud services"

D7.6
Standardization Plan and Activities

Project acronym: BASMATI

Project full title: *Cloud Brokerage Across Borders for Mobile Users and Applications*

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BASMATI Glossary

Term/Acronym	Definition
Mobile cloud services	Online services offered by cloud resources to support mobile apps. The backend of the mobile apps.
CP	Cloud Provider. The actor that provides the cloud infrastructure/resources, such as VMs
CSP	Cloud Service Provider. The actor that provides cloud services on top of a rent infrastructure from a CP
Cloudlet	Limited capacity infrastructures with virtualization capabilities, often used to support a limited amount of users or perform a limited set of operations on behalf of the central cloud infrastructure that hosts the complete application
Edge resources	Resources aimed to operate specialized functionality, located at the "edge" of the network infrastructure, thus, closer to the end users. Examples are (clusters of) RaspberryPis or cloudlets
BUDaMaF	BASMATI Unified Data Management Framework
KE	Knowledge Extractor
DM	Decision Maker
RB	Resource Broker
MVD	Mobile Virtual Desktop
DASFEST	An 3-day long music festival taking place in Karlsruhe, Germany every July
ACE	Amenesik Cloud Engine. The cloud service deployment tool through which actual federation is achieved
BEAM	BASMATI Enhanced Application Model. An extension of the TOSCA specification
ASP	Application Service Provider. A Federation user that rents resource services in order to provide an Application services to End-users
Brokering	The matchmaking support provided by BASMATI platform to decide about the best cloud resources to exploit for the execution of the back-end of BASMATI applications. This activity regards the placement of the services or data on computational resources and storages belonging to the cloud data centre and the cloudlets within the federation.
End user	A user who benefits the various application and infrastructure services provided by the Cloud. Within BASMATI, the most typical example is exploiting the Cloud federation via a mobile device (possibly a laptop) using specialized apps or a web browser.
Offloading	The ability of BASMATI platform supporting the runtime placement of the components composing the front-end of BASMATI applications on edge resources available nearby the end user. This activity takes place both when edge and mobiles exchange one each other their own workload or when such devices transfer some workload to the clouds or cloudlets. In BASMATI we often distinguish Front-end offloading, related to the mobile part of application, from Back-end offloading, concerning the server side of applications. The latter roughly translates to the known concept of Cloudbursting.

QoE	Quality of experience. It is a measure of a customer's experiences with a service. It may be related to some aspects of the QoS and QoP, but can also take into account other metrics.
Service handover	Service handover refers to the activity of transferring an active service between two computational resources (e.g. Cloudlets) with minimal or no disruption on the availability of the service. Ideally, service handover is transparent with respect to the user.
Situational Awareness	The ability of the BASMATI platform to recognise the “situation” characterising the actual combined status of users, applications and resources, aimed at achieving an effective and efficient management of applications and resources.

Executive Summary

This report addresses the standardization activities of BASMATI in terms of the adaptation of the existed standards to BASMATI development as well as the contributions and outputs to the target standard bodies as the final result of standardization. For the direct contributions of BASMATI on the standardization bodies, it presents the activities and outputs not only for the requirement and use cases of BASMATI for the cloud service brokerage in ITU-T SG13, but for BASMATI requirements for data storage and/or processing services and activities in DSM SWIPO WG. In addition, it presents the many existed standards, TOSCA, OCCI and WS-Agreement that BASMATI adapts for the interoperability.

Table of Contents

1 Introduction

After analyzing already developed standards and on-going projects in standardization organizations (SDOs), we decided to make contributions on ITU-T study group 13 (SG13)[1] and Digital Single Market (DSM) SWItching and POrting cloud service Providers (SWIPO) working group (WG)[2] as a target SDOs. And, we have contributed on on-going work items in ITU-T and "The Proposal for a Regulation of the European parliament and of the council on a framework for the free flow of non-personal data in the European Union" in DSM SWIOP WG.

For ITU-T, the on-going work item was about the cloud service brokerage which is a service that arbitrates, delivers, and manages cloud services provided by cloud service providers for cloud service customers. In seven meetings at ITU-T SG13 with dozens of contributions from BASMATI partners and also with the collaborations with other organization such as China Telecom, Microsoft, Orange Telecom, the work item has been approved as an International Recommendation (Y.3506)[3] at ITU-T in May 2018, which title is functional requirements for cloud service brokerage. To provide functional requirements for the cloud service brokerage, it specifies the overview including service model and configuration of the cloud service brokerage and requirements including the various use cases to derive the functional requirements. All details are described in Section 2.

For DSM, BASMATI contributed on SWIPO WG with materialising the knowledge gained from BASMATI project and collaborating with DSM SWIPO members to input the experiences and challenges that BASMATI faced in the collaboration with the other BASMATI partners. We will summerize the all activities in DSM SWIPO WG in Section 3.

Moreover, BASMATI has tried to adapt as many standards as possible, TOSCA[4], OCCI[5] and WS-Agreement[6] for the interoperability and the easier user interfaces of BASMATI platform. We will describe all details of the adaptation activities for the each existed standard to BASMATI platform in Section 4.

1.1 Relationship to Other Deliverables

This deliverable, deliverable D7.6, is based on two previous deliverables. On the one hand, it relies on the findings of deliverable D2.1, the State-of-the-Art and Requirement Analysis document. It provides details about the current technologies of cloud federations, the available economic models, and the challenges facing the development and acceptance of cloud federations as a viable business model. On the other hand, deliverable D7.6 uses the findings of deliverable D2.3, which provided the overall architecture of the BASMATI platform and the initial concepts and structures of the BASMATI platform components.

1.2 Outline of deliverable

This deliverable is organized as follows. Section 2 identifies the activities and the outputs in ITU-T. Especially, Section 2.1 presents the reason why BASMATI decided ITU-T SG13 as the one of SDO as the background and introduces the history of Y.3505 standard in Section2.3. Section 2.3 describes the details of Y.3506 on which BASMATI has made many contributions and the main BASMATI activities on Y.3505 will be shown in Section 2.4. Section 3 will detail the main standardization activities on SDM SWIPO WG for the data-related requirement and flow of BASMATI, and Section 4 will describe the adaptation of the standards to BASMATI, that are TOSCA, OCCI and WS-Agreement respectively.

2 Standardization Activities on ITU-T

2.1 Background

At the beginning of the BASMATI, mid of 2016, the de jure standardization organizations for the cloud computing were ITU-T SG13 and JTC 1 SC 38. ITU-T had three questions (Q17, Q18, and Q19), and each Questions has responsibility on the following issues;

- Q17/13: Requirements, ecosystem, and general capabilities for cloud computing
- Q18/13: Cloud functional architecture, infrastructure and networking
- Q19/13: End-to-end Cloud computing management and security

In case of JTC 1 SC 38, there are also three relevant WGs for cloud computing, and the main subject of each WG is like follows;

- SC 38 WG 3: Cloud computing Service Level Agreement
- SC 38 WG 4: Cloud computing Interoperability and Portability
- SC 38 WG 5: Data and their Flow Across Devices and Cloud Services

As one of the on-going items in the de jure standardization organizations of ITU-T SG13 and JTC 1 SC 38, ITU-T Y.csb-reqts (Cloud Computing- Requirements for Cloud Service Brokerage) was selected the target document for the standardization in BASMATI. It was not easy to carry forward BASMATI itself as a new work item because the BASMATI is a huge project composed of individual items. Furthermore, in terms of multi-cloud environment, since ITU-T Y.3511 (Framework of inter-cloud computing) was already approved and Y.ccic-arch (Functional architecture for inter-cloud) was imminent to be consented, we had to try to find on-going items which deal with the multi-cloud environments. A cloud service brokerage in Y.csb-reqts fundamentally assume the multiple cloud service providers and this point has relevance to BASMTI.

2.2 Development History of Y.3506 Standard

It was agreed to initiate new draft Recommendation of Y.csb-reqts at ITU-T SG13 Q17 in July 2016. The editors of Y.csb-reqts were appointed to Myeong-Hoon Oh (ETRI) and CHEN Nan (China

Telecom). The purpose of this Draft Recommendation is to offer functional requirements of cloud service brokerage. To provide its functional requirements, this document specifies the overview and logical components of cloud service. This document also identifies the various use cases to derive the functional requirements.

Through seven meetings (July 2016, Nov. 2016, Feb. 2017, July 2017, Sep. 2017, Nov. 2017, April 2018), Y.-csb-reqts had been updated by discussions among several vendors such as China Telecom, ETRI, Orange Telecom, ZTE, and Microsoft. The significant progresses were as follows.

- Definition of cloud service brokerage (CSB)
- Service model of CSB, i.e. aggregation, integration, and customization
- Logical component of CSB
- Functional requirements
- Identification of use cases and derived requirements

Y.csb-reqts was approved at ITU-T on 2018-05-29 and the official Recommendation is ITU-T Y.3506 [1] with the title of functional requirements for cloud service brokerage.

2.3 Introduction of Y.3506

2.3.1 Cloud Service Brokerage (CSB)

A cloud service brokerage (CSB) is a service between CSCs and CSPs, in which the cloud service broker arbitrates, delivers, and manages the cloud services from the CSPs to the CSCs. The objectives of CSB are to provide a single access, easy manage and value-added service to CSCs from multiple CSPs.

As shown in Figure 2-1, the CSB premises the multiple CSCs and CSPs environment. In CSB, a CSP registers cloud services to a cloud service broker and the cloud service broker configures a product catalogue with the registered cloud services. The cloud service broker also registers cloud services during the configuration of the product catalogue. Three service models (See clause 6.3) are implemented depending on how to configure the product catalogue in the cloud service brokerage.

When, a CSC requests a cloud service with CSC's requirements to the cloud service broker, the cloud service broker searches best-matched cloud services.

Once the CSC agrees with the condition (e.g. terms and price) of cloud service by the cloud service broker, the cloud service broker makes a contract with the CSC for brokering a cloud service. On behalf of the CSC, the cloud service broker requests to launch a cloud service to the CSPs and the access information from the CSPs is delivered to the CSC. Using the access information, the CSC accesses and utilizes the cloud service. During the use of the cloud service, the cloud service broker monitors and controls the cloud service on behalf of the CSC.

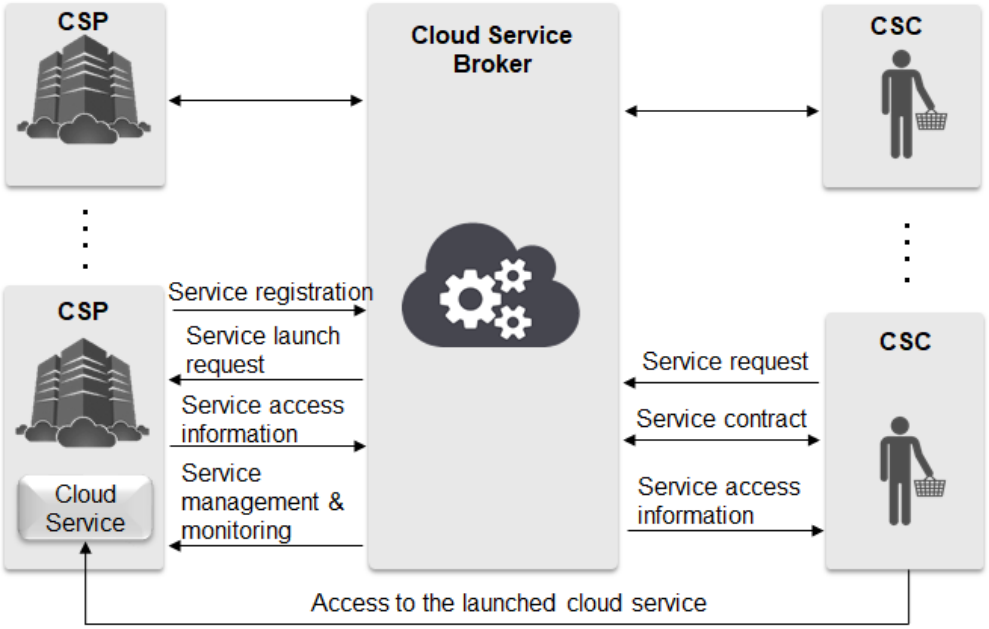


Figure 2-1 – Basic concept of cloud service brokerage

2.3.2 Service model of cloud service brokerage

The cloud services registered in the product catalogue of cloud service brokerage are categorized the following three service models.

- Cloud service aggregation: brings together cloud services from multiple CSPs to CSCs without any changes in a product catalogue. See Figure 2-2.
- Cloud service integration: collects registered cloud service in a product catalogue, making them work together to provide new cloud services in a product catalogue. See Figure 2-3.
- Cloud service customization: performs customized development by a cloud service broker on existing multiple cloud services in a product catalogue according to CSCs' demands. See Figure 2-4.

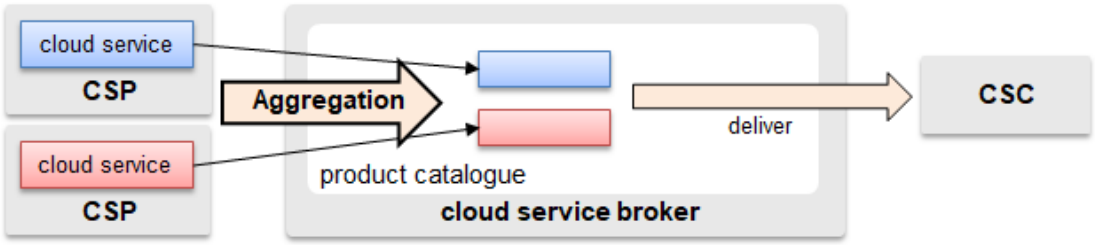


Figure 2-2 – Cloud service aggregation model

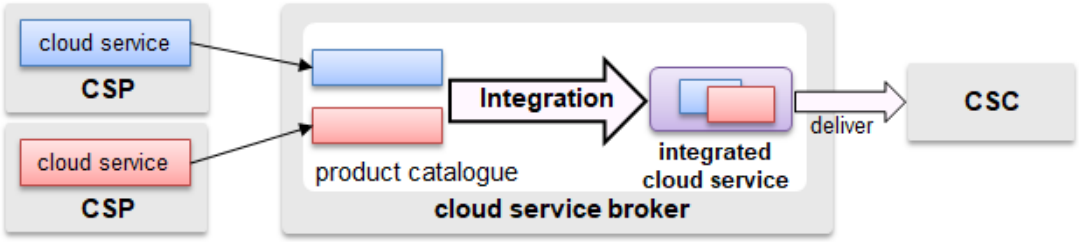


Figure 2-3 – Cloud service integration model

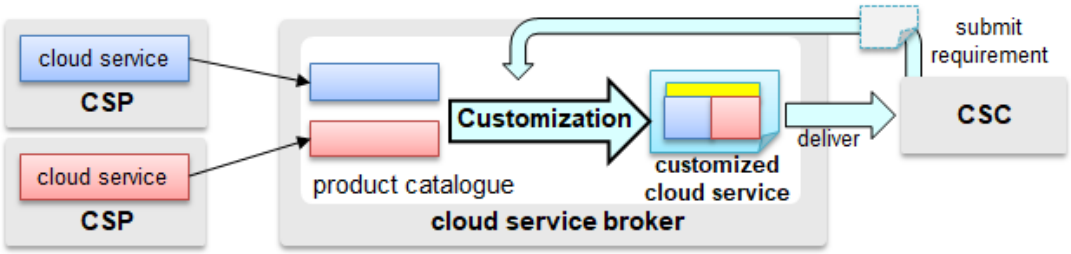


Figure 2-4 – Cloud service customization model

2.3.3 Configuration of cloud service brokerage

Figure 2-5 shows logical components of CSB. The logical components consist of workspace, product catalogue management, contract management, service access management, and service management.

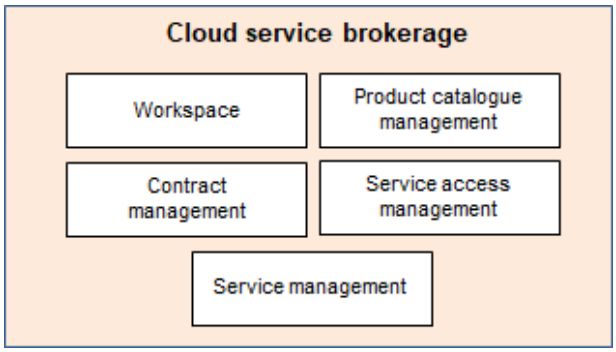


Figure 2-5 – Configuration of cloud service brokerage

Workspace logical component manages user accounts in CSB and provides user interfaces for CSPs and CSCs. This logical component handles authentication of users (i.e. CSPs and CSCs) and grants authorization for them to access other logical components in CSB. CSPs and CSCs perform requests and responses for all its operations through the user interfaces provided by this logical component.

Product catalogue management logical component provides registering, deregistering, and searching cloud services within a product catalogue in CSB to select cloud service by CSCs. Cloud services from multiple CSPs through workspace are registered and deregistered in product catalogue. This logical component performs supporting three service models of CSB described in clause 2.3.2 by managing registration into the product catalogue.

Contract management logical component manages contract between CSPs and CSCs in terms of cloud SLA. For the establishment of a contract, this logical component needs to create a cloud SLA document by using CSP's SLA and notify it to the contracted CSC. This logical component registers agreed service level to the service management logical component to guarantee the contracted service quality. If the cloud service fails to meet the service level, this logical component enforces remedies for failures to meet the terms of the SLA.

Service access management logical component requests to launch a contracted cloud service to the designated CSP. This logical component also manages access information of cloud services. In order to use to a cloud service, a CSC requires to get access information. After a CSP launches a cloud service, the CSP provides access information to a cloud service broker, and this logical component manages the information and delivers the access information to the CSC.

Service management logical component manages controls and status of running cloud services. This logical component delivers control requests for the running cloud services to CSPs in order to stop, resume, and terminate them on behalf of a CSC. This logical component also checks status of running cloud services by monitoring, and enforces service level agreed in a SLA. If a cloud service fails to meet the service level, this logical component needs to take an action to handle the situation by interacting with contract management logical component.

2.3.4 Functional requirements of cloud service brokerage

Following table summarizes the functional requirements of CSB. Detailed explanations of each functional requirement are skipped in this deliverable but desribed in [1].

Table 2-1 – Functional requirements of cloud service brokerage

logical components	Functional requirements
Workspace	- Authentication and authorization for workspace - Account management - User interface for CSCs - User interface for CSPs
Product catalogue management	- Registration of cloud service - Cloud service deregistration - Automation of service deregistration - Notification of service deregistration - Request for maintaining cloud service - Providing cloud service requirement template - Cloud service requirement validation

	- Cloud service search - Providing the best matched cloud service - Cloud service alteration - Cloud service substitution for integrated cloud service - Equivalent cloud service selection
Contract management	- Cloud service charging - Configuration of cloud service for contract - Service level objectives (SLO) selection - SLA document management - SLA description model - Remedies for failures to meet the terms of the SLA
Cloud service access management	- Delivering cloud service provision request - Delivering cloud resource request - Access information forwarding - Prohibiting access information storing
Cloud service management	- Cloud service SLA management - Cloud service monitoring - Delivering request of cloud service control - Validation of result for request of cloud service control - Initiation of validation - Status checking period for validation - History of cloud service control status validation - Notification of result for request of cloud service control - Detection of failures to meet the terms of the SLA - Prevention of service termination during migration

2.4 Main BASMATI Activities on Y.3506

During the development of Y.3506, to identify use cases were important because they can be basement of functional requirements, hence major contributions to Y.3506 for BASMATI have focused on proposing use cases with corresponding derived requirements.

2.4.1 Use case for cloud service migration in cloud service brokerage

As one of major contributions following figure describes a use case for cloud service migration in CSB.

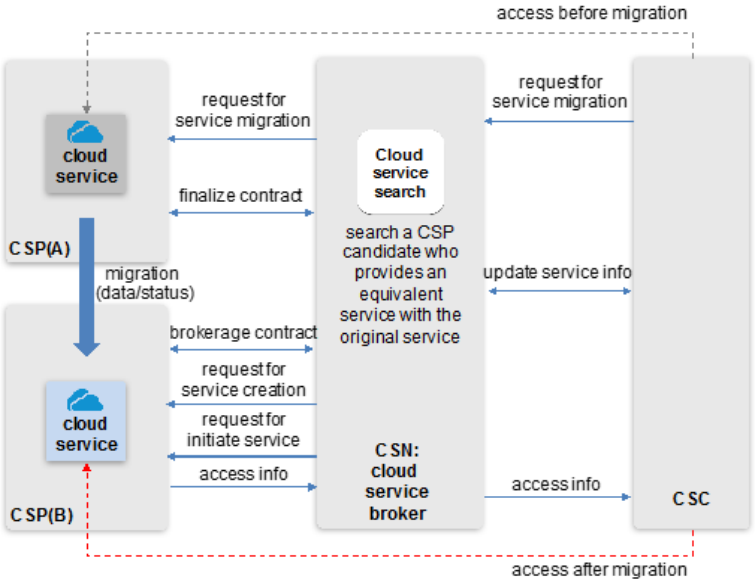
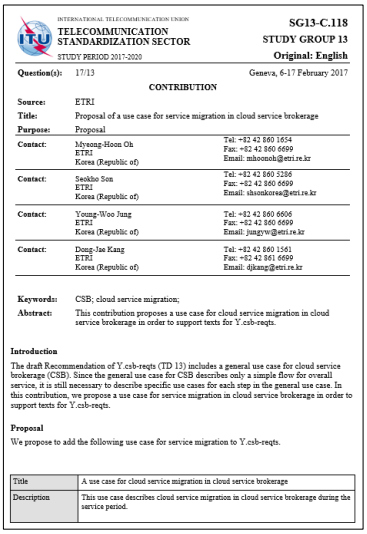


Figure 2-6. A use case for cloud service migration in cloud service brokerage



INTERNATIONAL TELECOMMUNICATION UNION
TELECOMMUNICATION STANDARDIZATION SECTOR
STUDY PERIOD 2017-2020

SG13-C.118
STUDY GROUP 13
Original: English

Question(s): 17/13 — Geneva, 6-17 February 2017

CONTRIBUTION

Source: ETRI
Title: Proposal of a use case for service migration in cloud service brokerage
Purpose: Proposal

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Keywords: CSB; cloud service migration;
Abstract: This contribution proposes a use case for cloud service migration in cloud service brokerage in order to support texts for Y.csb-reqts.

Introduction

The draft Recommendation of Y.csb-reqts (TD 13) includes a general use case for cloud service brokerage (CSB). Since the general use case for CSB describes only a simple flow for overall service, it is still necessary to describe specific use cases for each step in the general use case. In this contribution, we propose a use case for service migration in cloud service brokerage in order to support texts for Y.csb-reqts.

Proposal

We propose to add the following use case for service migration to Y.csb-reqts.

Title	A use case for cloud service migration in cloud service brokerage
Description	This use case describes cloud service migration in cloud service brokerage during the service period.

Figure 2-7. Contribution achievement for migration to Y.3506

The CSC is using a cloud service provided by CSP(A) under a contract with CSN:cloud service broker. The CSC determines to change physical location of the service according to some usage requirements. For instance, CSC, who operates a business using the cloud service, may determine to move business location to another country. The CSC makes a request to migrate the cloud service to the CSN:cloud service broker. The CSN:cloud service broker searches service catalogue to select a CSP candidate (CSB(B)) who provides an equivalent service with the existing service. The CSN:cloud service broker notifies updated service information due to the service migration.

On behalf of the CSC, the CSN:cloud service broker requests to create a service to the CSB(B) that can accommodates the service requirements. The requested CSP(B) creates a service according to the service requirements. The CSN:cloud service broker makes a request for service migration to CSP(A) so that CSP(A) migrates data and status of the existing service to the service created by CSP(B).

After CSN:cloud service broker confirms that the migration of status and data was accomplished, the CSP(B) initiates the created service using transferred data and status. The CSP(B) informs a creation of the service and provides information for accessing the service such as service access point, ID, and password to the CSN:cloud service broker. Using the access information, the CSC accesses and utilizes the created service. Finally, CSN:cloud service broker requests termination of the existing service to CSP(A).

This proposal was suggested in Feb. 2017 meeting as (C118, see the Figure 2-7) and reflected to table I.11 in Appendix I of Y.3506 [1] with two derived requirements.

2.4.2 Use case for cloud service customization in cloud service brokerage

As another major contribution to Y.3506 for BASMATI, we propsed the use case of cloud service customization as depicted in next figure.

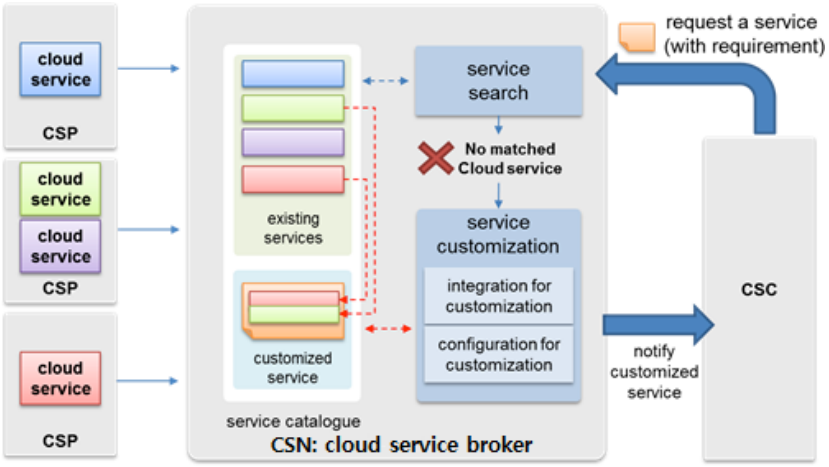
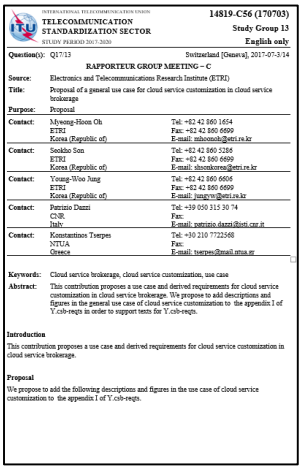


Figure 2-8. A use case for cloud service customization



14819-C56 (170703)
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Study Group 13
English only
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RAPPORTEUR GROUP MEETING – C
Source: Electronics and Telecommunications Research Institute (ETRI)
Title: Proposal of a general use case for cloud service customization in cloud service brokerage
Purpose: Proposal
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Keywords: Cloud service brokerage, cloud service customization, use case
Abstract: This contribution proposes a use case and derived requirements for cloud service customization in cloud service brokerage. We propose to add descriptions and figures in the general use case of cloud service customization to the appendix I of Y.csb-reqts in order to support tests for Y.csb-reqts.
Introduction
This contribution proposes a use case and derived requirements for cloud service customization in cloud service brokerage.
Proposal
We propose to add the following descriptions and figures in the use case of cloud service customization to the appendix I of Y.csb-reqts.

Figure 2-9. Contribution achievement for customization to Y.3506

Cloud service customization in cloud service brokerage is a service model to search, compose, and provide a customized cloud service to a CSC according to the CSC' service requirements. If a CSN: cloud service broker cannot discover a service that fulfils CSC's service requirements in the service catalogue, the CSN: cloud service broker integrates and configures existing services to composite a new customized service. Such as, layering new data and process functions, visibility and analytics, or incorporating a new look and feel to the service. CSC's service requirement can consist of multiple parameters such as service names, the amount of required resources, required service levels, required software, required configurations, and so on.

This proposal was suggested in June 2017 meeting as a contribution (C-56, see the Figure 2-9) with 5-6 derived requirements and reflected to table I.4 in Appendix I of Y.3506 [1].

2.4.3 Introduction of Resource Brokerage related Requirements in BASMATI

We have tried to submit a contribution regarding introduction of BASMATI project as well as use cases of cloud service brokerage. In this contribution, we introduced BASMATI project in which cloud brokerage for mobile users and applications is developed by EU-Korea consortium. We also proposed candidate items by introducing resource brokerage related requirements in BASMATI project.

The proposed candidate requirement items were classified in two parts, federation computing resources requirement and edge computing resource brokerage requirement. For the former, we recommended brokering resources belonging to foreign cloud accounts and SLA federation for federation computing resource requirements. For the latter, three requirements were introduced

like brokering between highly heterogeneous resources, intelligent brokering, and application deployment description.

This proposal was suggested in Noveber 2017 meeting as a contribution (C-326, see the Figure 2-11) and presented in ITU-T SG13 Q17 session by Konstantinos Tserpes (ICCS/NTUA) and Young-Woo Jung (ETRI).

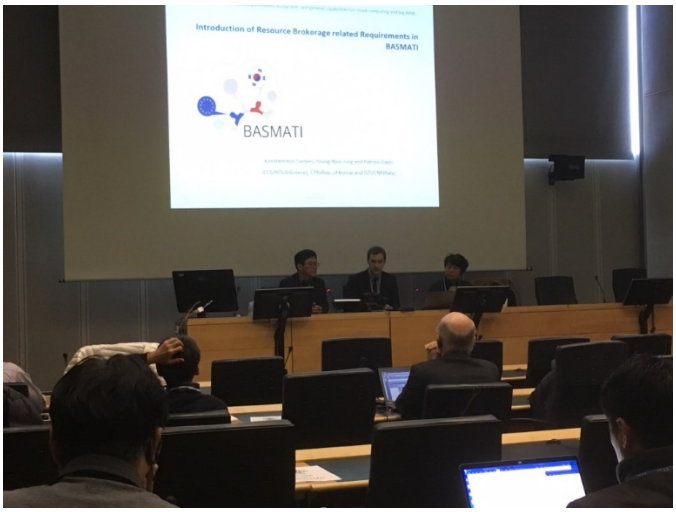
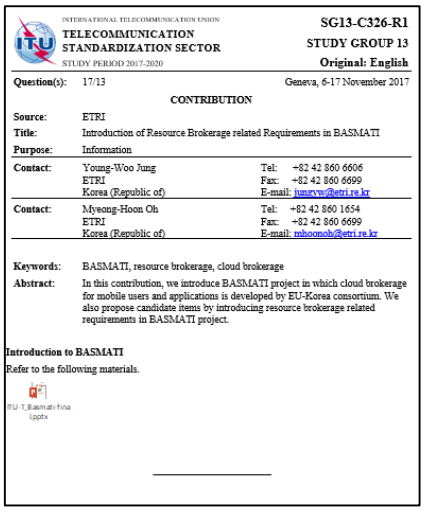


Figure 2-10. BASMATI introduction session in Nov. 2017



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STUDY GROUP 13
Original: English

Question(s): 17/13 Geneva, 6-17 November 2017

CONTRIBUTION

Source: ETRI
Title: Introduction of Resource Brokerage related Requirements in BASMATI
Purpose: Information

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Keywords: BASMATI, resource brokerage, cloud brokerage

Abstract: In this contribution, we introduce BASMATI project in which cloud brokerage for mobile users and applications is developed by EU-Korea consortium. We also propose candidate items by introducing resource brokerage related requirements in BASMATI project.

Introduction to BASMATI

Refer to the following materials.

ITU-T_Basmati-final.pptx

Figure 2-11. Contribution achievement for BASMATI introduction to ITU-T

2.4.4 Summary of contributions

Besides above contributions to Y.3506, we have proposed some contributions on concept of containers and micro-services to another on-going items, Y.cccm-reqts (Requirements for Containers and Micro-services) as a side standard activity. All contributions regarding standardization activities for BASMATI are listed in the following table 2-2.

Table 2-2. Summary of contributions of standardization activities for BASMATI

Num	Title	Organization	Phase	Draft Num	Data	Country
1	Initial draft Recommendation ITU-T Y.csb-reqts, "Cloud Computing-Requirements for Cloud Service Brokerage"	ITU-T SG13	Draft Rec.	TD 624 Rev.1	2016-07-07	Swiss
2	Proposal to add technology trends of CSB to a new livinglist of Y.csb-reqts	ITU-T SG13	Draft Rec.	C17	2016-11-17	Poland
3	Living lists of Y.csb-reqts (Warsaw, 14- 18 November 2016)	ITU-T SG13	Draft Rec.	TD17	2016-11-17	Poland
4	Proposal updated figure 6.2 in Y.cccm-reqts	ITU-T SG13	Draft Rec.	QKINT-1601114-C-20	2016-11-17	Poland

5	Output of draft recommendation ITU-T Y.cccm-reqts, "Cloud Computing – Requirements for Containers and Micro-services" (Warsaw, 14 – 18 November 2016)	ITU-T SG13	Draft Rec.	TD 12 (GEN/13)	2016-11-17	Poland
6	Output living list for draft recommendation Y.cccm-reqts, "Cloud Computing – Requirements for Containers and Micro-services" (Warsaw, 14 – 18 November 2016)	ITU-T SG13	Draft Rec.	TD 13 (GEN/13)	2016-11-17	Poland
7	Proposal of a use case for service migration in cloud service brokerage	ITU-T SG13	Draft Rec.	C118	2017-02-15	Swiss
8	Proposal for updated text for clause 6 in Y.cccm-reqts	ITU-T SG13	Draft Rec.	C151	2017-02-15	Swiss
9	Output draft Recommendation on ITU-T Y.csb-reqts, "Cloud Computing-Requirements for Cloud Service Brokerage"	ITU-T SG13	Draft Rec.	TD40	2017-02-15	Swiss
10	Proposal of a general use case for cloud service customization in cloud service brokerage	ITU-T SG13	Draft Rec.	C56	2017-07-14	Swiss
11	Living lists of Y.csb-reqts	ITU-T SG13	Draft Rec.	TD92	2017-07-14	Swiss
12	Proposal for updates of functional requirements in Y.csb-reqts	ITU-T SG13	Draft Rec.	C09	2017-09-08	Poland
13	Living lists of Y.csb-reqts	ITU-T SG13	Draft Rec.	TD128	2017-09-08	Poland
14	Introduction of Resource Brokerage related Requirements in BASMATI	ITU-T SG13	Draft Rec.	C326	2017-11-17	Swiss
15	Living lists of Y.csb-reqts (Geneva, 6-17 November 2017)	ITU-T SG13	Draft Rec.	TD147	2017-11-17	Swiss
16	Proposal for overall updates in clause 1 to clause 6 of Y.csb-reqts	ITU-T SG13	Draft Rec.	C27	2018-04-18	Swiss
17	Framework of Cloud Service Brokerage	TTA SPG21	stand ard	TTAK.KO-10.1042	2017-12-01	Rep. of Korea

3 Standardization Activities on Digital Single Market SWIPO Working Group

NTUA/ICCS is member in the Digital Single Market (DSM) Working Group on Codes of Conduct (CoC) for SWItching and POrting cloud service providers (SWIPO). SWIPO involves two sub-groups: IaaS sub-group and SaaS sub-group. NTUA/ICCS holds a position in IaaS sub-group as technical expert and represents the Providers side. In the following sections we will present the SWIPO

activities, discussions and drafting documents in which NTUA/ICCS has an active participation. The contribution of NTUA/ICCS in the DSM SWIPO group materialize the knowledge gained from BASMATI project. In the collaboration with the other group members, we offered our experience in the cloud domain and the challenges that we faced in BASMATI project with the other DSM SWIPO members. Because the outcomes of the DSM SWIPO group are based in a true working group spirit, we will present them in a holistic way.

Specifically, in the section 3.1 we will give a brief presentation of *The Proposal for a regulation of the European parliament and of the council on a framework for the free flow of non-personal data in the European Union* and we will focus on the article 6. Based on this regulation and specifically the article 6, the DSM SWIPO working group has been created. In the section 3.2, we will give a brief description of the DSM and the DSM SWIPO group. The section 3.3 gives a short description on the High Principles, Intellectual Properties, Governance, Terminology and some more auxiliary documents that the DSM SWIPO group has written to support its activities. The section 3.4 presents the main outcome of DSM SWIPO IaaS sub-group which is the IaaS Code of Conduct(current draft version 1.8). Finally, in section 3.5, we present some use cases that the DSM SWIPO group has agreed to support in the code of conduct and some topics that emerged from the use cases and are under discussion.

3.1 The Commission's proposal on the free flow of non-personal data

The Proposal for a Regulation of the European parliament and of the council on a framework for the free flow of non-personal data in the European Union that written on 13 September 2017 sets a framework for the cloud switching and the free flow of non-personal data between two different cloud services of Cloud Infrastructure Services Providers, or between the cloud customer on-premises facilities and a cloud service.

The purpose of the Regulation is to:

"achieve a more competitive and integrated EU market for data storage and/or processing services and activities." [7][8]

To meet this goal, the Regulation covers the following three issues:

- Improving the mobility of non-personal data across borders in the single market, which is limited today in many Member States by localisation restrictions or legal uncertainty in the market;
- Ensuring that the powers of competent authorities to request and receive access to data for regulatory control purposes, such as for inspection and audit, remain unaffected; and
- Making it easier for professional users of data storage or other processing services to switch service providers and to port data, while not creating an excessive burden on service providers or distorting the market. [7]

The Proposal for a Regulation of the European parliament and of the council on a framework for the free flow of non-personal data in the European Union contains ten articles that succinct described below:

- The Article 1 states the subject of the Regulation which is the free movement of no-personal data within the Union.
- The Article 2 states the scope of the Regulation which is the the storage and processing of electronic data in Union.
- The Article 3 provides the essential definitions such as data, provider, user, professional user, etc.
- The Article 4 gives the guidance of Free movement of data within the Union.
- The Article 5 states the availability of data for competent authorities.
- The Article 6 encourages the development of self-regulatory codes of conduct at Union level that defines the best practices for switching Cloud Providers.
- The Article 7 defines that a single point of contact will represent each member state and will lease with the other single points of contacts and the commission for the application of the proposal Regulation.
- The Article 8 states that the Free Flow of Data Committee will assist the Commission
- The Article 9 declares that the Commission will review the Regulation and present the outcomes on a report.
- The Article 10 covers the final provisions when the Regulation shall enter to force and apply.

As we mentioned above the Article 6 porting of data prompts Cloud stakeholders to write a self regulatory code of conduct at Union level that covers the guidelines on technical, legal and economical best practices for the switching of cloud providers. The article 6 spurred the creation of the Digital Single Market cloud stakeholder working groups [9]

3.2 Digital Single Market SWIPO Working Group

Digital Single Market translates the strategy of providing digital opportunities for people and business into policy actions and enhance Europe's position in the digital economy [10]. DSM provides an environment of fair competition, consumer and data protection, removing geo-blocking and copyright issues based on better access to digital goods and innovative services [11].

The free flow of non-personal data is vital for a competitive data economy and sets the goal users and companies to be capable to migrate their cloud stored data on their premises or to a different cloud server providers on an easy way with seamless operations and overcome the difficulties of legal uncertainty, lack of trust and the various technical difficulties of service provides [12]. To overcome these difficulties the SWIPO group has been created in order to develop a CoC that describes the regulations that should abide the cloud stakeholders.

The working group on cloud switching/porting data consists of two sub-groups that develops two different codes of conduct. The Infrastructure-as-a-Service (IaaS) sub-group and the Software-as-a-Service (SaaS) sub-group. The SWIPO group has bi-weekly conference calls and per two month face to face meetings. In the calls and the meetings, the participants make negotiations about the writing of the CoC, publish the draft versions of the CoC, request comments in a public process, and improve the CoC based on these comments. During the whole process of developing the CoC many issues may arise such as the need of a common terminology, an Intellectual Property Rights Policy, a Governance Agreement, etc.

The writing of a CoC is a painstaking work that takes into consideration legal, technical and economical aspects. The CoC constitutes a structured and standardised tool for the stakeholders to communicate and assess the various procedures that should be followed by the Cloud Service Providers (CSPs), the Cloud Service customers (CSCs) and the intermediaries. The four more important parameters that should be analysed are the processes, the technical requirements, the timeframes and the charges.

3.3 Auxiliary documents of DSM SWIPO Working Group

Some issues that relate with the CoC and SWIPO group are being addressed in separate documents. These documents will be added in the CoC or stay as a separate file. Most of them have not been finalised as the issues that cover are under discussion and stay in an ongoing status until the end of the CoC. We give a short and succinct description of them.

3.3.1 SWIPO Codes of Conduct: Common Terminology

A document that includes the common and most important terms regarding the domain of Cloud Computing is created with existing definitions of European and international standards. The writing of terminology is an on-going process during the CoC drafting as the need of new terms happens any time.

3.3.2 Governance Agreement for the Switching and Porting WG

The Governance Agreement defines the features of the SWIPO Group, specifically the composition of the group, the admission criteria and procedure of new members, the calling for a poll or vote, the decision making and voting, the rules of engagement and operation of sub-Working Groups and the coordination of the SWIPO group.

3.3.3 Intellectual Property Rights Policy

Intellectual Property Rights Policy concerns the policy of distribution and use of the CoC easily and without licensing impediments by users and vendors as well as other stakeholders.

3.3.4 SWIPO Codes of Conduct: Common legal aspects

Describes the reasons that prevent users from moving seamlessly between CSPs or transfer out their data from a CSP. It also mention the engagement requirements and the areas to be specified

in contracts. It also defines in a clear and unambiguous manner the term “portability" and the obligations between the data exporter and the data importer

3.3.5 Common high-level principles

It describes the high level principles that express the CoC. These are the interoperability, portability, predictability, transparency, compatibility and to be compatible with open standards.

3.4 Code of Conduct for Data Portability and Cloud Service Switching for Infrastructure as a Service (IaaS) Cloud services

The CoC defines the requirements and contractual specifications which the CSPs should adhere. The adherence on these responsibilities provides to the CSC the confidence that the CSPs can transfer its data in an open, transparent, predictable and meaningful way. The declaration of a CSP that adheres to the CoC has the prerequisite that it complies with all the following Requirements.

3.4.1 Requirements

The Data Portability and Interoperability & IaaS cloud services switching involves four sets of requirements, procedural requirements, data portability, scope and compatibility requirements and planning requirements

The Procedural requirements defines the processes that should be followed and allow CSCs to retrieve their data from CSPs, to upload their data to CSPs, or to port data between two CSPs. These are the initiation of switching and porting from the CSP when it is a porting source. The initiation of switching and porting to the CSP when it is a destination source. The declaration how the porting takes place. The CSP should advise and agree with the CSP about the terms and charges. The activation of a new CSP service when it is the porting destination. The CSP should manage the porting and switching process. The CSP should make the exit process in the source CSP after the porting process is accomplished.

The data portability requirements identify the technical measures and the legal obligations that support the porting process. The source CSP take all the reasonable steps to proceed the data transfer with an easy and secure manner. From the other side, the destination CSP should provide support for the interoperability between the CSC’s user functions, business functions and the cloud services and support for the CSC application programmatic access to the ported data. The destination CSP should facilitate the porting in an easily and securely way. These data will be in commonly used structures and machine-readable formats, but the CSPs are not required to transform the data in different formats. The transfer of data should follow open standards and protocols and as consequence the CSPs should support commonly used formats and packaging. If the data involves code artefacts, the CSPs should describe how they can execute the service dependencies and environment in which they will be executed. Last but not least the CSP shall provide an interface for data retrieval which can be subject for additional costs.

The scope and compatibility requirements should be defined in the Cloud Service Agreement (CSA) between the CSP and the CSC. These involve the extent of the data and the cloud service interoperability that concern the CSP switching and ensure that there will be no loss of functionality and high security. Derived data such as security records incident history are not a requirement for the CSP to be ported. But they can be ported if it is clearly agreed and described in the CSA.

The planning requirements are included in the CSA and concerns performance, testing of APIs and pricing mechanisms. The testing of APIs concern the APIs for porting data and the APIs to access and manage the stored data. The CSA should also define the anticipated volume of data, the appropriate duration for the transfer, the transfer rate, the minimum network bandwidth, and the period the ported data will be available to the CSC. The CSA can also include an allocation of security responsibilities such as access control, authentication of users integrity and confidential through the process.

3.4.2 Contractual Specifications

The role of CoC is not to replace the CSA. The CSA defines the terms between the CSPs and CSCs but the contractual rights and the obligations of the CoC are not diminished by the CSA. The CSA can be in writing form such a single document, a set of documents, online terms and conditions.

The transparency should be ensured by the CSPs. This involves that the terms and conditions should be notified to the CSCs. In addition, the CSPs should describe to the CSCs all the mechanisms that concern the porting of data. These mechanisms involve the tools that they use, the available support that the CSPs offers, descriptions of the data porting processes, how the CSPs handles the CSCs data after the exit process, a description of anyone who have access to the CSCs data through the porting process and a description in any kind of conversion, translation and transfer of the data from a third-party service.

A description of the mechanisms related to the porting of the data should be provided from the CSPs to the CSCs, this involves the procedures, terms and conditions, costs and policies concerning the porting, technical, physical and organisational measures to undertake the porting. The data model, data semantics and schema should be explained for functional and no-functional data, the locations where the data going to be stored and the costs that would be charged by the CSP.

In general, the CSPs should made available to the CSCs all the information related to data portability and in case of any change to the conditions and mechanisms the CSPs should inform the CSCs timely and the CSCs would have the right to terminate the agreement.

3.5 A collection of use cases the SWIPO WG Code of Conduct has agreed to support

We present four use cases as they discussed and designed in the physical meeting on 17 April of SWIPO group in Brussels. These use cases covers the topics that concern the data porting and

switching cloud infrastructures and depict all the main issues that involves the process. The use case 1,2 and 4 summarise in a concrete way the main guidelines of the the porting process, while the use case 3 discusses the emerged issues of the porting process, the CSA and the CoC

3.5.1 Use Case and topics of discussion 1

The porting process can be divided in two different cases. In the first case the CSC downloads his data on his premises from the source CSP and then upload his data to the destination CSP. In the second case the data transfer takes place directly between the two CSPs.

In both cases it should be arranged a number of issues between the CSPs and the CSCs. These are the definition of import and export formats, the cost of the process, the handling of meta-data, the implications of cross-border transfers with EU and third countries, obligations of a CSP in the continuity of the service during the process of porting.

3.5.2 Use Case and topics of discussion 2

The exit strategy within a migration concerns firstly, a compose of terms and conditions and the description for the exit process. Afterwards, there should be an export-interface that should specify the existed restrictions, the tools that will be used, the format of data, a documentation for the CSP tools. It is also important to be described a set of deletion topics such as the responsibilities of data deletion, potential copies, the retention time and the tools that will be used.

The switching porting process may involve many types of data such as raw data, meta data, log files, configuration data, enriched data based on the needs of the CSP, restored procedures and server scripts and functions. All of them cannot be handled with the same way and may exist specific agreements about them in the CSA.

3.5.3 Use Case and topics of discussion 3

The main questions and guidelines that should cover the CoC concern to distinguish what is part of CoC and what of CSA, if the CoC will give guidelines about the confidentiality and security of the data porting process. Finally it emphasizes that the CoC should express a market concept.

3.5.4 Use Case and topics of discussion 4

The use case 4 describes the case that a small company that grows up need to proceed to data transfer but the dependencies prevent it. In this situation are also organisations that are locked in and cannot change to a new CSP without having to stop their services. When an organisation adopts new technology that concerns different CSPs, it should need to transfer its data to the CSP that support the new technology. Lastly, it is mentioned the need of synchronisation and cooperation between the source CSP with the destination CSP in order to take place the porting process while the services of the CSC be online.

4 Activities to Adapt Standards to BASMATI

4.1 Background

The creation and promotion of new international standard is often the focus of standardization activities within collaborative projects whereas the adoption and subsequent promotion of existing international standards is frequently neglected. The standardization life cycle is, by necessity, a lengthy process, involving several lengthy phases, and consequently the creation and imposition of new standard during short duration projects such as BASMATI it is not a realistic objective. With this clearly in mind the standardization activity within the BASMATI project has been focused on the usage, adaptation and integration of existing standards in the field of cloud computing.

Since the advent of public offer of cloud computing, making a striking appearance, roughly in the years around 2010, with the emergence and commercial predominance of AMAZON AWS followed quickly by the arrival of its first major contender in the form of the first versions of OpenStack, and due to the operational disparity between these two giants, a vast amount of research activity has been dedicated to the reconciliation of not only their overlap but also their differences and resulting in the emergence of three major standards.

On the operational and control plane level, the Open Cloud Computing Interface (OCCI) published and managed by the Open Grid Forum (OGF), provides a solid and fully interoperable rationalization of the concepts, introduced and made available with the arrival of the version 1.1 of HTTP, and nowadays referred to by the term Representational State Transfer (REST). OCCI defines a standard format for the description, discovery and invocation of the objects and actions for the construction and maintenance of Client / Server Remote Procedure Call Scenarios respecting the REST paradigm. The standard provides not only the CORE technology but also a collection of standardized object formats that not only demonstrate the potential of the standard but open the door to its employment for the construction of a complete and standardized control plane management system.

During the same period, and at the application description level, the Topology Object Standard for Cloud Applications (TOSCA) published and managed by OASIS, provides a solid framework for the description of cloud applications not only in terms of their infrastructure requirements but also in terms of their middleware, software configuration, topological relationships and deployment. This standard provides an XML and a YAML based grammatical framework along with a preliminary collection of standardized base definitions for the fundamental concepts involved in cloud computing.

Finally, again during the same period, a third standard known as WS-Agreement, also published by the OGF, emerged providing a flexible generic framework for the description, negotiation and management of service level agreements. This standard provides an XML grammar for the

description of both business to customer (B2C) and business to business (B2B) commercial service level agreements and comprises an abstract and extensible service description section that can be combined influenced by service condition terms. In addition, the standard provides for the description of the all-important service level guarantees, often referred to by the term Key Performance Indicators (KPI), allowing full description of the requirements and control of the service level operations with respect to the engagement of both parties to the agreement.

The adoption of the core concepts and grammatical frameworks, provided by these three international cloud standards, was the basis on which the subsequent elaboration of the BASMATI ENHANCED APPLICATION MODEL (BEAM) was made possible.

4.2 TOSCA on BASMATI (BEAM)

During the BASMATI project, and to support and facilitate the subsequent application description activities, a TOSCA XML processor was designed and developed as an extension to the Amenesik Cloud Engine (ACE) that provides the basis for the cloud provider management and deployment aspects of the BASMATI platform.

The TOSCA processor is invoked during the creation of an Application Controller OCCI instance for the transformation of the BEAM/TOSCA description and the production of the WS Agreement Application State description documents.

The following extensions have been added to the TOSCA standard to meet the needs of the BASMATI project. In all cases, care has been taken in order that these extensions in no way disrupt the standard constructions of the underlying TOSCA grammar with an aim to preserving interoperability with other TOSCA based cloud management systems.

The Cloud Provider definition has been added allowing the default cloud provider to be specified for use in the deployment of hardware nodes. This can be defined for specific machines using the customary node template property construction whereas the default value, for all other nodes, may be specified as a global Service Template Tag.

The Geographical Region definition has been added allowing the default deployment region to be specified for use in the deployment of hardware nodes. This can be defined for specific machines using the customary Node Template Property construction whereas the default value, for all other nodes, may be specified as a global Service Template Tag.

A collection of default monitoring probes can be specified via global Service Template Tags with additional Probe Definitions being specified for individual hardware nodes through the Node Template Property.

A new node type has been defined allowing probe characteristics to be specified through Node Template definitions. These nodes can be attached to hardware node template definitions through the customary Node Template Requirements definitions.

The scalability of a hardware node may be defined using Node Template Properties indicating the elastic floor, the elastic ceiling, the elastic upper and lower thresholds. This information will be delivered into the lifecycle management section of the resulting deployment agreements for the various Application State instances.

Software installation and post-configuration instructions maybe provided in the standardized actions of the Node Implementation Deployment Consideration corresponding to the life cycle change events create, start, stop and delete.

BEAM / TOSCA document processing operations are associated with OCCI TOSCA instances for logging and other commercial or platform governance-oriented concerns.

The BEAM / TOSCA adaptations are described in detail with extensive examples in the BASMATI deliverable “D3.1 Analysis and Modelling of Users and Applications: Design and Specification” and the deliverable “D3.2 Analysis and Modelling of Users and Applications: Software Prototype”.

4.3 OCCI on BASMATI

To facilitate the use of OCCI by the partners in BASMATI a OCCI standard software agent or client was developed for the Python language and will be made available for use under opensource license.

The OCCI publication service of ACE component of the BASMATI platform is used by all partner components for the publication of availability of their services.

ACE provides an exhaustive OCCI API for fine integration and management of its underlying component services. These interfaces are used in particular by the integration with the Resource Broker for the discovery and management of cloud wide resources and by the Application Controller for Application Deployment and Life Cycle management and control.

The Federation management component has been added as an OCCI category allowing remote management of the Federation configuration of a particular federation members platform by a central authority in the corresponding Federation topology types.

The Application Controller and its associated Application States have been implemented as extensions to OCCI standard and make extensive use of the OCCI interfaces of ACE.

4.4 WS-Agreement on BASMATI

The OCCI based WS Agreement management system of ACE has been extended to allow configuration and control of the Federation Member management through Business to Business Service Level Agreements.

The Service description of the operational Service Level Agreements may be provided as follows:

- Business to Customer: in this case the Service Description will be an ACE Manifest document resulting from the transformation of the Service Template of a BEAM document.
- Business to Business Provider: in this case the Service Description will be a Provider document containing resource availability quota and pricing information to be used to control allocation and deployment of resources through the corresponding interfaces.
- Business to Business Federation: in this case the Service Description will be a Federation document containing nested provider and or manifest documents describing the not only the provider resources made available but also the technical application configurations that may be exploited through the resulting federation member relationship.

The Service Conditions sections may be used to describe Service Description modifiers that may limit or enhance the availability or usage of applications or resources described in the Service Description section.

The Service Guarantees section may be used to specify operational constraints to be imposed on either party to the agreement during the operational life cycle of the service as described in the Service Description section. Key performance indicators and their associated business valued actions and behaviors may be described here specifying the required operational limits and consequences.

Cloud Federation Agreements

Cloud federation member Service Level Agreements are a combination of the cloud resource and application provider agreements providing a complete description of offers of service by a particular member of a cloud federation.

- The quota descriptions of resources made available through the collection of provider interfaces by the federation member.
- The commercial conditions and pricing for the offered applications and resources
- The management of placement, reservation, consumption and release of the applications and resources
- The commercial conditions concerning the invoicing and payment of resource and application usage by the Basmati platform operator.

In BASMATI the Federation Service Level Agreement used is a derivation, or specialization, of the international standard known as WS-Agreement. The extension describes a new service description element that will be used to describe the technical and commercial details of a mono or bi-direction relationship between two federation members. This information is encoded within the Agreement Context field called ServiceProvider, the value of this string field determines the nature of the agreement, in terms of half or full duplex and the nature

of the responsibility of both the initiator and the responder. Values for this field must be Initiator, Responder or Both.

Both the SLAM and the Cloud Provider management within BASMATI are WS-Agreement compliant. The aforementioned modules can work in combination to manage and monitor at runtime the different service levels parameters agreed in the contract. On one hand, the SLAM module takes care of the Customer requirements defined by the cloud-based applications while the Cloud Provider Manager takes care of the functional requirements that need fulfilled in order to be able to place the requested computational resources on the target Cloud Service Providers. The outcomes of the discussions regarding the Federation Service Level Agreements is documented under the internal report "FederationServiceLevelAgreementsv10e", the specifications described there have been used to govern the relationships between members of Basmati Federation and describes the nature conditions and extent of this relationship type.

Further information, relating to the use of WS Agreement for the definition and management of Service Level Agreements within the scope of the BASMATI platform, may be found in the BASMATI deliverables relating to "D5.5 Quality, security and privacy enforcement: Design and specification", "D5.6 Quality, security and privacy enforcement: Software prototype ", "D4.1 Dynamic Cloud Federation: Design and Specification" and the "D4.2 Dynamic Cloud Federation: Software Prototype".

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