Validation Framework - Version A

Accompanying descriptive document of prototype deliverable

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## Abstract

This document complements deliverable D8.2 of BRIDGET, which is the prototype deliverable "Validation Framework – Version A", with some descriptions about the prototype itself. The corresponding prototype deliverable consists in the actual technical infrastructure set up for running the user trials of BRIDGET tools developed for Version A, documented in referenced deliverables D3.1, D4.1, D5.1 and D7.1, which includes an installation of the applications that will be validated in a dedicated technical infrastructure set up in RAI laboratories in Torino.
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1 Executive summary

This document complements deliverable D8.2 of BRIDGET, which is the prototype deliverable “Validation Framework – Version A”, with some descriptions about the prototype itself. The corresponding prototype deliverable consists in the actual technical infrastructure set up for running the user trials of BRIDGET tools developed for Version A, documented in referenced deliverables D3.1, D4.1, D5.1 and D7.1, which includes an installation of the applications that will be validated in a dedicated technical infrastructure set up in RAI laboratories in Torino.
2 Introduction

The guiding principle of the validation framework design is to evaluate how the technical tools developed in the first 18 months of the project are suitable to implement a first end-to-end production cycle for bridgets. This concept is illustrated in Figure 1, where a classical production workflow starting from a piece of content to be enriched and ending with the usage of the resulting second screen application is illustrated. In the authoring phase, the validation framework will support testing of the main functionalities designed and implemented in the Professional Authoring Environment to generate and manipulate bridgets for an input programme. During this phase, professional users will be involved to test the BRIDGET Professional Authoring Tool.

In the interaction phase, the validation framework will support the evaluation of the performed authoring actions through the presentation and usage of the bridget experience resulting from them. In this phase end users will be invited to test the End-user BRIDGET Application.

![Figure 1- End-to-end validation.](image)

3 Validation Framework for Version A of BRIDGE Tools

This section contextualises the Validation Framework in the overall application environment defined in work package 8 and presented in its first version in [1]. It also adds some technical information about the validation framework infrastructure and logistics.

3.1 General principles and definitions

The Validation Framework for Version A of the BRIDGE tools is a set of technical components integrated with the purpose of evaluation of some key technologies and applications developed for Version A, in line with the principles set in [1]. Figure 2, taken from D8.1, recalls the general high-level architecture of BRIDGE applications.
The components which will be validated at this round are a subset of all the components developed for Version A, including relevant parts of the BRIDGET Professional Authoring Environment and of the End user’s BRIDGET Application, i.e. the two components of the BRIDGET proof-of-concept which are meant to be used by two categories of real users: professional users and end-users.

3.2 BRIDGET Professional Authoring Environment

In the context of the Professional Authoring Environment, the Professional Authoring Tool will be the main component subject to validation, together with the Media Analysis Subsystem and the Visual Search Subsystem (see red parts in Figure 3). While the former will be evaluated directly, i.e. through direct usages of all its functionalities in a trial exercise, the latter two will be evaluated indirectly, namely it will be evaluated if the results provided by the two subsystems are of appropriate quality and relevance for the exercise.

Functional and technical details of the components subject to validation can be found in [2] [3] and [4]. A detailed description of the authoring trial exercise will be reported in “D8.4 – Testing Guidelines – Version A”.

*Figure 2 – Reference Architecture of the PoC and validated subsystems.*

*Figure 3 – The BRIDGET Professional Authoring Environment components subject to validation.*
3.3 BRIDGET End-user Environment

In the context of the End-user Environment, the Launcher, the Bridget Player and the Synchroniser will be the components subject to validation (see red parts in Figure 4). The first will be evaluated in terms of efficiency in recognising the change of programme, the second in terms of overall presentation of content and the related ergonomic and functional aspects for the user, the last in terms of efficiency in keeping the right synchronisation with the end user’s main screen. Technical and functional features of the components under validation can be found in [4]. A detailed description of the end-user trial exercise will be reported in “D8.4 – Testing Guidelines – Version A”.

![Figure 4 - The end user’s BRIDGET Application components subject to validation.](image)

3.4 Technical & logistic setting

This section illustrates the technical infrastructure and the hardware and device deployment which is part of the validation framework. Such an infrastructure has been designed in conformance to the principles presented in [6]. This section contains some updates an additional details deemed relevant for illustrating the user trials infrastructure.

3.4.1 Technical infrastructure set up for user trials

The BRIDGET platform developed for user trials consists of two major components:

- Processing Platform
- Software Platform

The BRIDGET Processing Platform contains the processing units (physical or virtual), operating systems, network and infrastructure. It is designed to allow flexibility, interoperability, scalability and ease of deployment. In this context, we propose a cloud structure based on virtual clusters. All the computation resources are provisioned in a virtual cluster, not in a physical cluster. The virtual cluster is a manageable entity based on the need to dedicate a portion of the physical infrastructure, with a dedicated set of machines, as part of the same virtual cluster. The concept of virtual cluster (and virtual cluster node) bring the operational efficiency of the system in that all the administrative tasks required...
to manage the lifecycle and the elasticity of a virtual cluster instance can be reliably and repetitively automated by the system. In general, there will be a one-to-one mapping between the virtual resources spectrum and the physical resources spectrum. For example, CPU affinity policies will apply when assigning a physical CPU core to a VM’s vCPU.

In general, virtual clusters are homogenous (all the nodes are instantiated using the same OS image, have the same number of vCPUs, the same amount of RAM and the same software packages deployed). The platform should allow the deployment of a hybrid type of cluster where the nodes differ in the number of vCPU, amount of RAM and software packages deployment. This can be viewed as a PaaS (Platform as a Service) approach but the particularity of the processing calls introduces the necessity of a custom service that will store and schedule the processes according to the cluster infrastructure.

A configuration management system is used throughout the system, to enforce the consistency of the software that is installed in any virtual cluster instance. This is done by way of running a special program where all successive versions are handled in a central source code control repository. Thus, the provisioning of a fully geared virtual cluster instance could be replayed as many times as necessary though a simple API call.

A virtual cluster is comprised of a complete stack of pre-installed and pre-configured software packages running on one or multiple cluster node instances which altogether constitute an operational virtual cluster on which end-users can launch performance intensive tasks. A virtual cluster may come in different flavours or implementations that are specified in the virtual cluster manifest.

In summary a virtual cluster can be thought of as a pre-built setup that a user could customise in terms of number and flavours of compute nodes, I/O nodes and visualisation nodes to get the required processing and storage capacity.

As shown in Figure 5, there is a well-defined layer based architecture to support the instantiation of Virtual Clusters. The layer based structure ensures flexibility by providing mechanism to add or remove physical machines, manage the entire system, handle OS images, handle templates (virtual cluster definitions), storage volume configurations, and configure each node.

Each node is instantiated based on an OS image and does not contain any custom pre-installed packages nor software. At each cluster restart, the node is instantiated based on the same image and the custom software packages are deployed at each boot – everything that is deployed after the instantiation is volatile. This technique ensures the flexibility of using the same base images to deploy a type of hybrid cluster, where one of the nodes is in charge with the exposure of the storage volumes to the nodes.
As shown in Figure 6, the hybrid virtual cluster consists of different types of nodes. Each virtual cluster is instantiated based on a template which contains definitions such as the node types (each node type contains the number of vCPUs and amount of RAM), storage and gateway layers configuration.

The network must be partitioned at the virtual cluster level in tight virtual subnets to enforce:

1. traffic isolation across the virtual clusters instances
2. a quality of service (QoS) setup to reserve bandwidth for the various categories of traffic
3. ensure that the services can be accessed from outside the virtual cluster’s internal network (through a gateway)

The platform has to ensure that all the nodes can communicate with each other directly (through sockets, pipes etc.) and by opening files generated/saved by other nodes (by having access to the common storage space). As shown in Figure 7, the nodes are connected to the same virtual LAN and the Gateway node has 2 interfaces, one with a virtual LAN IP and the other can be configured with a public IP address.
A common storage space is exposed to all the nodes as a non-volatile volume. The stored data is persistent and is not vulnerable to cluster reconfigurations and start/stop procedures.

To ensure proper functionality of the entire platform, minimum and optimal characteristics are defined. These parameters are strongly dependent on the applications requirements such as: processing power, amount of memory, storage space, data access time.

The following table presents the characteristics for each processing machine:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Minimal</th>
<th>Amount</th>
<th>Optimal</th>
</tr>
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<tr>
<td></td>
<td>2 x Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz</td>
<td>4 x Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz</td>
<td>8 x Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz</td>
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<tr>
<td>CPU cores</td>
<td>fpu vme de pse tsc msl pae mce cx8 apic sep mtrr pge mca cmov pat clflush mmx fxsr sse sse2 syscall nx lm rep_good unfair spinlock pni pclmulqdq sse3 cx16 sse4_1 sse4_2 x2apic popcnt tsc_deadline_timer aes hypervisor lahf_lm</td>
<td>fpu vme de pse tsc msl pae mce cx8 apic sep mtrr pge mca cmov pat clflush mmx fxsr sse sse2 syscall nx lm rep_good unfair spinlock pni pclmulqdq sse3 cx16 sse4_1 sse4_2 x2apic popcnt tsc_deadline_timer aes hypervisor lahf_lm</td>
<td>fpu vme de pse tsc msl pae mce cx8 apic sep mtrr pge mca cmov pat clflush mmx fxsr sse sse2 syscall nx lm rep_good unfair spinlock pni pclmulqdq sse3 cx16 sse4_1 sse4_2 x2apic popcnt tsc_deadline_timer aes hypervisor lahf_lm</td>
</tr>
<tr>
<td>CPU flags</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>RAM</td>
<td>2 GB</td>
<td>4 GB</td>
<td>8 GB</td>
</tr>
<tr>
<td>Network</td>
<td>1 x GBit</td>
<td>1 x GBit</td>
<td>1 x GBit</td>
</tr>
<tr>
<td>Persistent Storage space</td>
<td>1 TB</td>
<td>2 TB</td>
<td>4 TB</td>
</tr>
<tr>
<td>(shared)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristic</td>
<td>Amount</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimal</td>
<td>Medium</td>
<td>Optimal</td>
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<td>Persistent Storage space read performance</td>
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<td>40.00 MB/sec</td>
<td>50.00 MB/sec</td>
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<tr>
<td>Persistent Storage space write performance</td>
<td>10.00 MB/sec</td>
<td>15.00 MB/sec</td>
<td>20.00 MB/sec</td>
</tr>
<tr>
<td>Local Storage space read performance</td>
<td>40.00 MB/sec</td>
<td>60.00 MB/sec</td>
<td>100.00 MB/sec</td>
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<tr>
<td>Persistent Storage space write performance</td>
<td>20.00 MB/sec</td>
<td>40.00 MB/sec</td>
<td>60.00 MB/sec</td>
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<tr>
<td>Scratch Storage Space (volatile)</td>
<td>2 GB</td>
<td>4 GB</td>
<td>8 GB</td>
</tr>
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Currently, the operating system for the components of BRIDGET processing platform is CentOS 6.6 X86_64.

The BRIDGET Software Platform can be defined as a Software as a Service (SaaS) and contains the software packages with the corresponding deployment and configuration rules.

All the software packages and their dependencies should be packaged in a standard format such as RPM or TAR-BALL. The processing platform allows collecting and installing software from different versioning systems (such as SVN, GIT or by calling a plain HTTP request). The deployment rules should be written as a part of the Node's deployment rules (usually using Chef Recipes). Any additional configurations or operations can be specified using scripting languages (server can be supported).

There are strict rules regarding the software deployment: location, dependencies location and execution rules. Several software packages that use the same dependencies but with different versions, can be deployed on the same node without any interference. The execution rules should specify the dependencies loading location and priority. A proposed structure is presented in Figure 8.
In general, a node is not directly accessible from outside the virtual cluster (Figure 9). The only node that has a public IP address is the gateway node. A load balancing mechanism can be implemented to redirect the request to the least loaded node that is able to handle the client request (contains the corresponding software).

As shown in Figure 10, all the nodes can access the internal communication network (nodes can exchange data) and can access the common space. All BRIDGET tools (back-end, API, interface etc.) can be executed by any node making handling client requests both easy and balanced. This type of architecture has multiple advantages such as supporting hybrid organization of node, scalability and predictability.
Figure 10 – Virtual Cluster – Internal organization
3.4.2 User Devices

Within BRIDGET, we will mainly focus on user devices that run Android OS. The constraints for these devices include: GPU acceleration support, a minimum of 1 GB amount of RAM memory, network connection and a minimum OS version of Android 4.0.0.

The user device chosen as reference platform for the development and the project demonstrations is the Huawei MediaPad M1 (Figure 11), which has the following characteristics:

<table>
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<th>Amount</th>
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<tr>
<td>Operating system</td>
<td>Android OS, v4.2.2 (Jelly Bean)</td>
</tr>
<tr>
<td>RAM</td>
<td>1GB</td>
</tr>
<tr>
<td>CPU</td>
<td>Hisilicon Kirin 910 - Quad-core 1.6 GHz</td>
</tr>
<tr>
<td>Screen size</td>
<td>8 inches</td>
</tr>
<tr>
<td>Screen resolution</td>
<td>800 x 1280 pixels</td>
</tr>
<tr>
<td>GPU</td>
<td>Mali-450MP4</td>
</tr>
</tbody>
</table>

Table 2 - HUAWEI MediaPad M1 characteristics.

![Figure 11 - A picture of Huawei Media Pad M1 tablet](image)

3.4.3 Network

The BRIDGET network infrastructure is designed to facilitate and support the communications and interactions among the main five distributed elements defined in the BRIDGET architecture, as depicted in Figure 12.
Figure 12 - BRIDGET Network Architecture

The **Bridget and Content Server** (Bridget Repository) stores the Bridget-enriched media contents generated by the Professional Authoring Tool. Logically, it can be defined a **Serving Node** and it can be accessed via Internet by the (Hybrid) Virtual Cluster and by each Bridget End User Peer.

The stored contents are retrieved through their URL location (basically, a bridget identifies a resource stored in the repository using its URL path).

The **Programme Repository** (Digital Asset Management system) and the **Broadcast Planning** provide access to the original programmes to be Bridget-enriched and to their schedule information. Logically, they can be defined as **Serving Nodes** and they can be accessed via the Internet only by the (Hybrid) Virtual Cluster.

The **(Hybrid) Virtual Cluster** is the core element of BRIDGET Network architecture. Logically, it can be defined a **Border Node** and it can be accessed via Internet only by the Professional User. It consists of different types of nodes, each of them implementing different functionalities in the Professional Authoring Peer. The nodes are connected to the same virtual LAN via Gigabit Ethernet and the Gateway node has 2 interfaces, one with a virtual LAN IP and the other can be configured with a public IP address. It’s important to remark the great importance of this public IP address interface, because the Virtual Cluster needs to communicate and manage a large amount of data downloaded from the Programme Repository, and to access the Bridget Repository to store the bridgets once they have been generated by the authoring process.

Thus, because of the large amount of media content data that the Virtual Cluster needs to access and manage, it’s recommended to use:

- High capacity downstream connection between the Programme Repository and the Virtual Cluster, e.g. Hybrid Optical Fiber Solution (Fiber To The Cabinet Technology, up to 30 Mbit/s downstream via VDSL2), Pure Optical Fiber Solution (Fiber To The Home Technology, up to 100Mbit/s downstream), ADSL2+ (up to 20 Mbit/s downstream).
• High capacity upstream connection between the Bridget Repository and the Virtual Cluster, e.g. Hybrid Optical Fiber Solution (Fiber To The Cabinet Technology, up to 3 Mbit/s upstream via VDSL2), Pure Optical Fiber Solution (Fiber To The Home Technology, up to 10Mbit/s upstream).

*The Professional Authoring Tool Application* is a web application accessing and managing all the Virtual Cluster functionalities via the Internet. Logically, it can be defined as an End Node and it can be used only by the Professional User in the production environment.

*The End User Application* is a BRIDGET compliant application running on portable second screen devices. Logically, it can be defined an End Node and it provides the End User the opportunity to access and enjoy bridge-enriched media contents stored in the Bridget Repository via Internet.

The second screen device should connect to the home network via WLAN interface (IEEE 802.11 b/g/n up to 450 Mbit/s downstream), and access the Bridget Repository via Internet using high capacity downstream connection, e.g. Hybrid Optical Fiber Solution (Fiber To The Cabinet Technology, up to 30 Mbit/s downstream via VDSL2), Pure Optical Fiber Solution (Fiber To The Home Technology, up to 100Mbit/s downstream), ADSL2+ (up to 20 Mbit/s downstream).

3.4.4 Logistic information

The validation will take place in RAI's premises in Torino between beginning of July and mid-September 2015. The components of the BRIDGET Professional Authoring Environment will be tested by a panel of professional users selected among RAI's production personnel. The End-user BRIDGET Application will be evaluated by a focus-group of users. Details about approaches at testing, validation exercises, testing modalities and user’s feedback management will be included in deliverable “D8.4 – Testing Guidelines – Version A”.

4 Content used during validation

The content used for validation purposes is selected from the material made available by RAI to BRIDGET, in the context of Task 8.5 of Work Package 8. The material has been chosen for its relevance to the scenarios defined in [5].

4.1 Content used to validate the BRIDGET Professional Authoring Environment

To validate the BRIDGET Professional Authoring Environment we will use a shortened episode of the RAI programme “Sereno Variabile”. This programme is particularly interesting for its editorial structure, which allows to put under test some relevant authoring functionalities of the Professional Authoring Environment.

In particular, the selected material contains rich audio and video features, e.g. many universally known places (e.g. “Ponte Vecchio” in Florence), people (e.g. Niccolò Machiavelli) and stories (e.g. the Medieval battle between Guelfi and Ghibellini) are presented (see Figure 13) so that it is easy to foresee that many enrichments could be searched by metadata and reused from previous programmes.

![Ponte Vecchio](image1)
![Niccolò Machiavelli](image2)
![Guelfi and Ghibellini standards](image3)

*Figure 13 – Samples useful to exploit metadata search functionality*
In addition, many bridgets could be reused within the programme itself, since the same people and places are showed several times during the clip (e.g. the presenter Osvaldo Bevilacqua, the Basilica of Impruneta).

Another important peculiarity of this material is the presence of many buildings and monuments (e.g. the Dome of the Duomo in Florence), enabling a professional editor to make use of the visual search feature provided by the Authoring Tool to retrieve related images. Figure 14 shows some samples of people, places and monuments presented during the clip.

Furthermore, this content brings a lot of historical, local and social curiosities and notions (e.g. the "Hills of Chianti", the "Terracotta of Impruneta" and the "Beefsteak Florentine style") useful to stimulate the exploratory creativity of professional users in the process of creating bridgets (see Figure 15).

4.2 Content used to validate the End-user BRIDGET Application

To validate the End-user BRIDGET Application we will use the following content items:

- Some news items taken from one issue of a RAI newscast programme;
- A portion of an episode of a kids’ entertainment programme titled “Gulp girl”; 
- A piece of the popular talk show “Porta a Porta”.
- A piece of premium content about Madama Butterfly Opera;

The set of selected items allows for a rich set of presentation features to be tested and validated by end-users. All the above items will be shown on a main screen during the testing sessions, and the Player application will show enrichment content on a handheld device on synchronised basis. The fundamental characteristics of the above mentioned content items will be described in the following sections.

4.2.1 Newscast

The news content contains four news items extracted from one issue of a newscast programme. The clip is about ten minutes long.
The first two items are about Italian politics, reporting on different economic aspects of the relationship between Italy and the European Community. Within this part enrichments about the subject of the news and about people showed during the clip (e.g. Matteo Renzi, José Manuel Durão Barroso, Pier Carlo Padoan) are proposed by the player through different sections of the bridge presentation template (see Figure 16).

The remaining items are about two Italian social phenomena, such as the internal war against Mafia and the political discussion about the possibility to adopt the German model for gay unions. These subjects are enriched within a couple of bridges reporting information about relevant people. Figure 17 shows how these further bridges are presented.

4.2.2 Gulp Girl

This programme aims to deliver to its target audience (young kids) interesting information about lives and curiosities about their preferred show business’ star, including how they are used to make up or dress. This is done by making the programme’s host, named Benedetta, wear and make-up the same thanks to the collaboration of a make-up expert, Federica, and two outfit experts, Giulia and Francesca. The clip of the selected episode, during about seven minutes, is about the famous actress Hilary Swank, and several kinds of bridges are related to her make-up.

At the start and at any time during her experience, the user can enjoy a global bridget containing information about the programme and the presenter, as showed in Figure 18. As soon as the star is introduced, a subsequent bridget becomes active shortly after that Benedetta starts talking about her (see Figure 19).
Since the talk is done during the make-up, a bridget containing info about used cosmetics is also presented (see Figure 20).

While conversing about the great career of the famous actress, Benedetta presents several films Hilary Swank had been starring in, and at the same time a bridget for each mentioned film is activated, with interesting info and pictures, as shown in Figure 21.
Figure 21 – Films bridges

Much additional information about Hilary's awards and filmography are given by another bridge (see Figure 22).

Figure 22 – Awards and filmography bridge

Once the main clip ends, all enjoyed bridges are presented together, with the addition of a funny game challenging the user to try to dress the presenter as much as possible similar to the guest star (see Figure 23).
4.2.3 Talk show

This content is a piece of the popular talk show “Porta a Porta” featuring an interview with several guests in the studio about the Costa Concordia’s shipwreck. The selected portion of the episode is about 9 minutes long.

After a bridget concerning the programme in general (see Figure 24), two bridgets about the ship are presented, with images of the Costa Concordia before and after the incident, technical information related to the ship and curiosities about its history (see Figure 25).
Three other bridgets are about the presenter, Bruno Vespa and the two interviewed people, the maritime director of the Tuscan Coast Guard, Arturo Faraone, and the director of the Concordia wreck removal project, Sergio Girotto. These bridget are showed in Figure 26.
4.2.4 Opera

The last genre of content selected to validate the End-user BRIDGET Application is a piece of premium content about the Puccini’s Madama Butterfly Opera. This eight minutes long clip has to be considered as a sort of summary of the whole Opera and its plot built by choosing parts of the opera containing key moments of the show and popular arias as “Un bel di vedremo”.

At the time of writing of this document the related prototype development is still in progress, so we report only information about planned bridgets. Images are extracted from the storyboard and not from the actual prototype yet.

Different kinds of bridgets have been considered in the authoring of this content, in order make the experience more attractive. The first one brings some global information, such as the history of the theatre hosting the show or the plot of the Opera (see Figure 27).

![Figure 27 – Static Info bridgets](image)

The second kind of bridget considered as being of interest is the one with external links, which allows the user to explore further info and materials (e.g. links to other programmes talking about the Opera, links to info about films using parts of this Opera as soundtrack) related to a specific part of the mainstream, as showed in Figure 28.

![Figure 28 – Bridgets with external links](image)

Another important feature converted in a specific type of bridget is the rich amount of curiosities related to the Opera, such as the reaction of Pascoli after the flop at the premiere of Madama Butterfly in 1904, the relation of Puccini with the Japanese world, or the origin of the idea of the final hara-kiri. This kind of bridgets is presented in Figure 29.

![Figure 29 – Bridgets about curiosities](image)
Finally, a bridge containing second views of some parts of the Opera is also planned, through which the user can enjoy the representation from different angles and points of view (see Figure 30).

![Second view bridges](image)

*Figure 30 - Second view bridges.*

5 **Conclusions**

This document briefly describes the validation framework set up to validate some key components developed by the project for Version A. It complements the actual prototype deliverable D8.2 "Validation Framework – Version A".

6 **Acknowledgements**

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7 **References**

## Appendix A – Partners List

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