Project Number: **034702**

Project Acronym: **BEinGRID**

Project Title: **Business Experiments in Grid**

Instrument: **Integrated Project**

Thematic Priority: **Advanced Grid Technologies, Systems and Services**

White Paper: Integrating an SLA architecture based on components

Activity 1: *Technical Common Cross Activities*

WP 1.2: *Architecture solution and Interoperability*

Due Date:		M30
Submission Date:		26/01/2009
Start Date of Project:		01/06/2006
Duration of Project:		42 months
Organisation Responsible for the Deliverable:		Name of Organization
Version:		0.4
Status		Final for submission
Author(s):	Igor Rosenberg Ana Juan	Atos Origin Atos Origin

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

Version History

Version	Date	Comments, Changes, Status	Authors, contributors, reviewers
0.1	16.12.2008	Skeleton, some text on BEinGRID methodology	Igor Rosenberg (Atos Origin)
0.2	13.01.2009	Update	Igor Rosenberg (Atos Origin)
0.3	26.01.2009	Updated based on internal Review	Igor Rosenberg (Atos Origin) Ana Juan (Atos Origin)
0.4	26.01.2009	Final for publication	Igor Rosenberg (Atos Origin)

Table of Contents

1. Executive summary

This document presents an integrated architecture for handling SLAs. The analysis of situations arising in Grid experiments resulted in this architecture, after several refinment iterations. This architecture is based on stand-alone components, and its minimal instance comprises of SLA Negotiation, SLA Resource Optimization, SLA Evaluation and SLA Accounting. A scenario is presented to place the architecture in context. Some future directions are also mentioned.

2. Introduction

2.1 Purpose

The purpose of this document is to show that the components, developed in a group called the "BEinGRID SLA cluster", could be used collectively to provide an integrated SLA architecture. This architecture allows the management of the full lifecycle of SLAs. In this document will be described:

- a high level SLA architecture based on components
- a business scenario that can be addressed using an instance of the architecture
- an analysis of the possible improvements

This document is a shortened but updated version of the paper presented in [8].

2.2 Context

The reader must be familiar with general computer science paradigms such as SOA, GRID, and be prepared to receive a presentation of a general software architecture targeted at supporting SLAs. SLAs are used as a means to control the QoS promised by the provider; the user is provided with a copy of the original document, which can later be referred to in case of non-compliance to pledges.

2.3 References

[1] Analysis of Common Technical Requirements. BEinGRID AC1 meta-deliverable integrating D1.1.1, D1.3.1, D1.4.1, D1.5.1, D1.6.1

[2] Design patterns for SOA and Grid. BEinGRID AC1 meta-deliverable integrating D1.1.2, D1.3.2, D1.4.2, D1.5.2, D1.6.2

[3] Validation Scenarios & Best Practices. AC1 meta-deliverable integrating D1.1.3, D1.2.4, D1.3.3, D1.4.3, D1.5.3, D1.6.3

[4] Web Services Agreement Specification (WS-Agreement). A. Andrieux et al., Specification from the Open Grid Forum (OGF), 2007

[5] Implementing WS-Agreement in a Globus Toolkit 4.0 Environment. D. Battré, O. Kao, K. Voss Usage of Service Level Agreements in Grids, *Workshop in conjunction with The 8th IEEE International Conference on Grid Computing (Grid 2007), September 2007*

[6] Conference on Grid Computing (Grid 2007), September 2007 Ganglia Website, http://ganglia.info

[7] The ganglia distributed monitoring system: design, implementation, and experience. M. L. Massie, B. N.Chun, *D. E. Culler, Parallel Computing 30 (2004) 817–840*

[8] An SLA Framework for the GT4 Grid Middleware, Igor ROSENBERG, René HEEK, Ana JUAN, in *Collaboration and the Knowledge Economy: Issues, Applications, Case Studies, Paul Cunningham and Miriam Cunningham (Eds), IOS Press, 2008 Amsterdam, ISBN 978–1–58603–924-0*

2.4 Glossary of Acronyms

Acronym	Definition
BE	Business Experiment
BEinGRID	Business Experiments in Grid
CC	Common Capabilities
DP	Design Pattern
CTR	Common Technical Requirements
GT4	Globus Toolkit 4 middleware
QoS	Quality Of Service
SLA	Service Level Agreement
SOA	Service Oriented Architecture
SOI	Service Oriented Infrastructure
SP	Service Provider

3. A high level SLA architecture

3.1 BEinGRID requirements, Common Capabilities, and Design Patterns

Within the BEinGRID ICT FP6 project, 18 so-called Grid Business experiments (BEs) were executed in parallel, during a first experiment wave, solving business problems with Grid solutions. A technical group, the SLA cluster, extracted from these the following:

- Common Technical Requirements, which capture the essence of several challenges mentioned by one or more BEs. The common technical SLA requirements, which correspond to needs during given periods of the SLA life-cycle, have been prioritised based on their business drivers and technical relevance. All requirements are equally important, but the classification is based on 18 real-world scenarios presented by the BEs. The final list of requirements for the SLA topics in order of appearance in the SLA life cycle is:
    1. SLA Template Specification: For a resource provider, a clear step-by-step procedure describing how to write an SLA template to provide with correct (and possible legal) service description
    2. Publication and Discovery: Publish the provider offer, the customer QoS needs, and browse/ compare offers in a federated marketplace
    3. Negotiation: Bargain-like transaction to agree SLA conditions between the customer and the provider.
    4. Optimization of Resource Selection: Optimal resource management on the provider side (selection of the most suitable host) improving the current scheduler solutions.
    5. Monitoring: Provide measures of the ongoing process, i.e. system values related to the SLA for internal and external usage
    6. Evaluation**:** Comparing all the terms of the signed SLA with the metrics provided by the monitoring, in order to internally prevent upcoming violations and to externally discover potential violations
    7. Re-negotiation: Changing the terms of an already accepted (enforced) SLA
    8. Accounting: Charging the consumer for the use of services contracted by signing SLAs
- Common Capabilities (CCs), which represent a given SLA functionality. A CC is a description of a specific functionality. It represents a single or a group of technical requirements. Negotiation and Re-negotiation requirements were merged, as well as Monitoring and Evaluation.
- Design Patterns (DPs) are architecture-level documents, which describe a possible implementation of a CC. Only for the most relevant common capabilities have design patterns been produced. The SLA Template Specification is standalone in the sense that it does not require a component being developed. On the other hand, the Publication & Discovery common capability has not lead to the development of a component, even though a solution needs to be proposed - a discussion of a solution is drafted in the Deliverable D.1.3.3. of BEinGRID.

3.2 The components and how to integrate them

Several software components were implemented by choosing a target technology for Design Patterns. The choice of the target technology reflected the gap analysis which was performed on the original BEs. The BEinGRID project developed the following components:

a) SLA Negotiation for GT4,

b) SLA Optimisation of Resource Selection for GRASP,

c) SLA Optimisation of Resource Selection for GT4,

d) SLA Monitoring and Evaluation for GRASP,

e) SLA Monitoring and Evaluation for GT4,

f) SLA Evaluation for GRIA,

g) SLA Accounting for GT4

The reader should now compare these components to the basic SLA lifecycle (this lifecycle corresponds to the different requirements defined above):

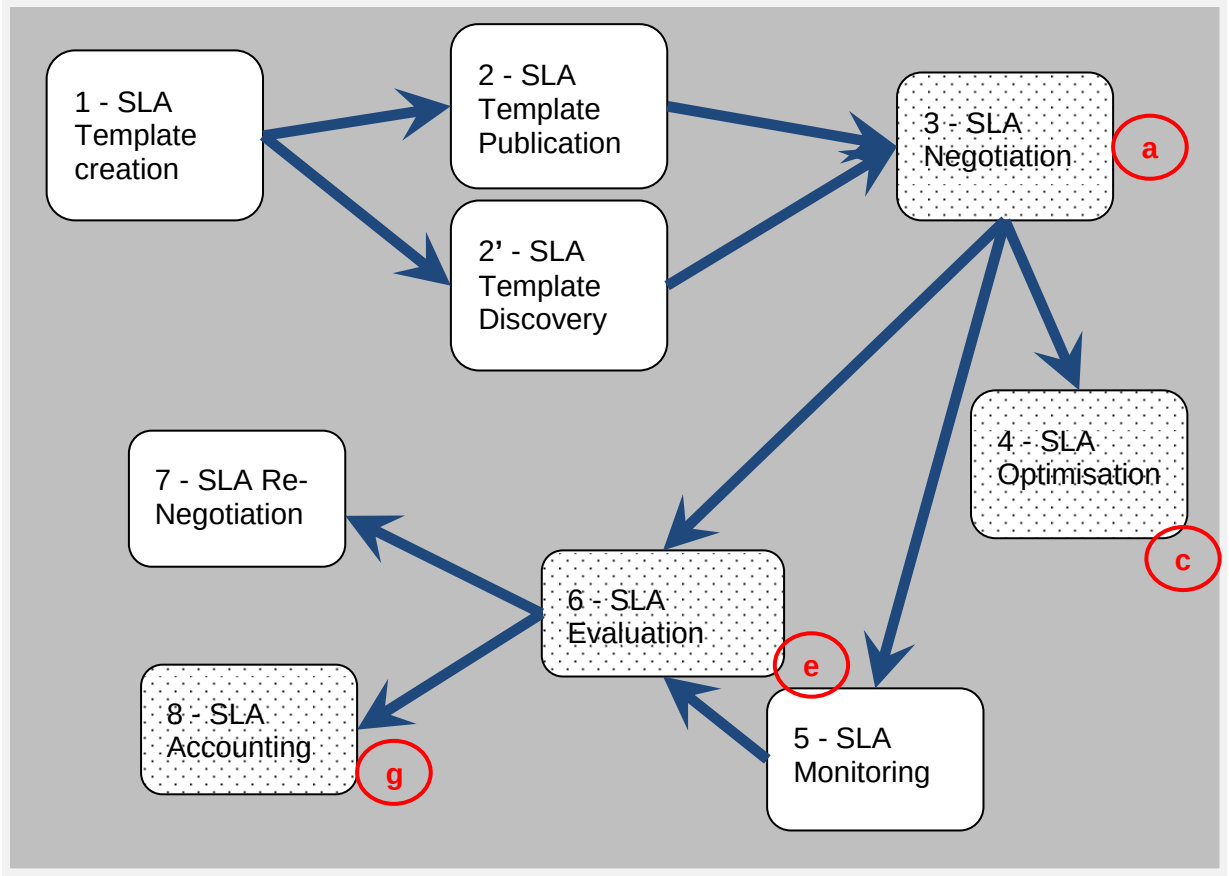

Figure 1 Basic SLA Lifecycle

It can be noted that the doted steps of the lifecycle above have a corresponding implementation for GT4 (requirements of letters a, c, e, g) provided as BEinGRID

components (the step 5 – Monitoring can be provided by external tools, for example the Ganglia or Nagios frameworks). Hence the provided components can be put together and are sufficient to build an SLA architecture, targeting the Globus Toolkit 4 middleware. The work of the integration of the mentioned components is not a difficult, as the components were developed for the same target middleware, using the same supporting Web Service framework (the GTv4 Java WS Core). Such an integration is being done (target deadline March 2009 – the components themselves are all implemented as of Jan 15th 2009) within the BEinGRID technical work, and a virtual image of a Linux operating system produced, demonstrating the feasibility of such an integration.

The integrated architecture that will be implemented corresponds to the drawing below, which presents in full lines the existing components. The provider then only has to develop his own negotiation strategy, and tune the optimisation algorithm defining personal business rules.

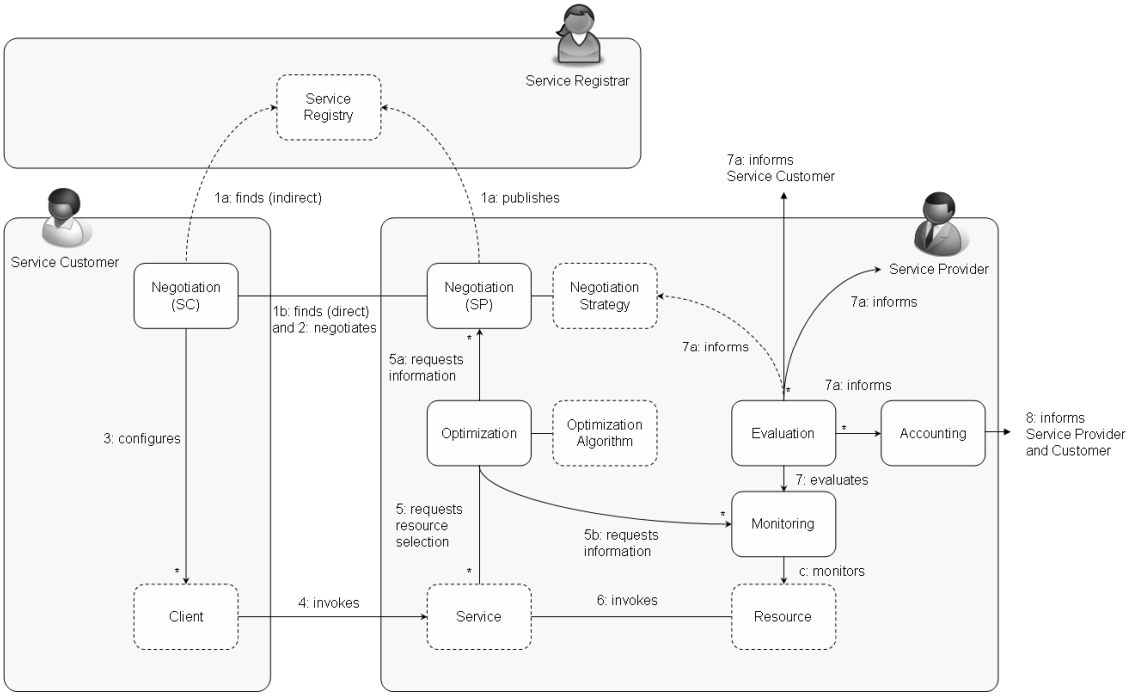

Figure 2 – Architectural Overview of the SLA Management Framework for GT4

The Negotiation component implements most of the interfaces suggested by the WS-Agreement [4]specification. Only some XML terms of the SLAs documents in WS-Agreement have been removed due to the incompatibility of these terms with Axis 1. The component supports the synchronous as well as the asynchronous negotiation of agreements and therefore provides a high-level of interoperability within the framework and for external clients. An easy plug-in mechanism for domain-specific negotiation strategies allows service providers to adapt the component to their requirements, e.g. respect the information provided by the evaluation component. The same plug-in mechanism for integrating domain-specific implementations of SLA template and SLA repositories is used. Implementations of file-based repositories are available. Related work was taken out by the AssessGrid project [5]and the implementations have been peer reviewed by members of each project.

The Resource Optimization component uses the agreed SLA and the Grid resources information to select the most appropriated resource where to run the job. The optimization algorithm can be customized to adapt to a particular application domain, or provider business rules.

The Monitoring and Evaluation component is in charge of controlling the execution of an SLA. Each resource is monitored, and its metrics are sent to a centralizing point. The information is then archived in a database (to keep records against litigations, but also for accounting). In parallel, the guarantees of the SLA are evaluated against these metrics. Violations and threats (when metrics break a warning threshold) are sent as notifications, for example to the service consumer and the service provider. Different notifications will correspond to different levels of implication in the provider's Grid infrastructure. The component has a set of evaluation rules, which define what functions to apply to discover violations and threats. The proposed implementation relies on the Ganglia [6][7] framework to monitor resources, and offers a bridge to store the metrics in a database. It also offers the notifications as WS-Notifications, with different topics corresponding to different confidence levels.

The SLA Accounting component retrieves from a database the metrics corresponding to the monitoring of the services used. This component then prepares a draft of a billing sheet, based on the price and penalties exposed in the SLA. The official financial department of the provider company must produce the real bill.

4. A Business Scenario

Using once again the SLA lifecycle, a scenario can be built which highlights the necessity of SLAs and their supporting components. The following (simplified) situation is inspired from the twenty-fifth BE of BEinGRID, BE25 (second wave of Bes, validating the results), which presents an appealing case for the use of SLAs.

A resource provider sometimes suffers peak demand of computer cycles from its usual clients. The provider decides to rely on a secondary provider, which provides the extra resources to satisfy the punctual high demand. To simplify the situation, the resource provider is renamed the Client, and the secondary provider is named the Provider

The Client and Provider have a long standing relation, and as such have set a business partnership, allowing that sharing of resources can be initiated in a very efficient way. The solution chosen is to sign a framework contract that defines the maximum and minimum requirements of the Client, the responsibilities of the Provider, and making legally binding the following SLAs.

When under peak demand, the Client triggers the negotiation of a punctual SLA, which governs the access to the extra resources for a limited amount of time. The negotiation needs to start with the need of the Client, and ends with an XML document standing as a contract between both parties, transferring temporarily the use of the Provider's resources to the Client. The BEinGRID SLA Negotiator is perfectly fit for this role.

The Provider, in order to maximise the resource usage, implements an advanced scheduler which takes into account the business value of the SLAs into its scheduling algorithm, adding this into its decision criteria to reallocate resources. The Client has no involvement in this process, as it is internal to the Provider. The Provider relies on it to accommodate is multiple clients who are competing for the resources, enabling the Provider to offer the resources to the more lucrative Clients (depending on internal business rules). The BEinGRID Resource Optimisation component is perfectly fit for this role.

Once the SLA is signed, the Client and Provider need to be informed of its progress, and of any violation which could occur during the lifespan of the SLA. The Client wants to check that the resources are conceded under the pacted conditions, while the provider must make sure that unexpected resources failure is elegantly resolved, with the minimum impact on the Client. The provider, owning the resources, can deploy an extensive monitoring framework, and deduce very detailed reports of its ongoing activity. A trimmed down version of this information must be passed on to the inquisitive Client, as it appears as a condition of the contract signed. The BEinGRID SLA Monitoring&Evaluation component is perfectly fit for this role.

As described in the introduction of the scenario, the SLA signed has a limited lifespan, corresponding to peak demand. When its period is over, the resource usage must be summed up and presented to the billing department of the Provider, which in turn will charge the Client on the basis of this report. The report must mention any violations which occurred, and also reflect the price for resource consumption which was agreed at the time of the signature of this particular SLA. The BEinGRID SLA Accounting component is perfectly fit for this role.

The business scenario describes the use of four BEinGRID components based on the GTv4 middleware. The components integrate smoothly to offer an architecture which solves the business need of offering resources on demand, with a price possibly varying on demand, and which are later billed depending on the execution conditions.

5. Possible improvements

There exist some complementary capabilities and components to the basic architecture presented in this paper. Below some SLA capabilities not addressed within BEinGRID are stressed, and then the extension of the SLA functionality to other thematic areas is proposed.

The BEinGRID approach proposes a theoretic approach to the problem, through Common Capabilities. These CCs do not cover in sufficient detail the initial steps of the SLA lifecycle. The Publication and Discovery aspects have been disregarded, as the BEs, needing a solution applying to a very limited set of actors, do not need it. Nonetheless, considering possible solutions to the problem of putting providers and users in contact is worthwhile. Quickly one can mention a (more or less free) marketplace infrastructure, or a broker acting as an intermediate between the interested actors (this last case is developed within another FP7 project named AssessGrid[1]).

The different SLA Capacities presented can be integrated with other thematic areas. For example, some security advances can be coupled, for example to secure the transactions. The SLAs could also concern accessing data, in which case there could stem a need to virtualise or homogenise this data access. The user and provider can also be interested in managing all the SLA functionality within a single interface, possibly offered through a portal. These extensions should be addressed through tighter collaboration with the other thematic clusters of BEinGRID, for example through the PEP/PDP (security) for authentication, through the Data discovery (data management) to match the published templates to the prospective users (or also possibly to construct a combined offer based on the user's requirements), or also integrating SLAs in a more general resource management portlet within a general portal solution for IT management (portals)

[1] FP7 project ending in March 2009, see http://www.assessgrid.eu

6. Conclusion

This white paper insisted on the integration of various components produced by BEinGRID, and how a realistic scenario backs up the proposal. A summary table of the proposal follows:

AC1 capabilities	Component adopted	Business Benefits	Alternatives
SLA Runtime Monitoring	BEinGRID SLA Evaluation and Monitoring for GT4	The SLA during the actors is evaluated during runtime, which allows then to take compensatory actions to limit the impact in non-compliance	Different monitoring frameworks exist, but do not check again an SLA
SLA Negotiation	BEinGRID SLA Negotiator for GT4	The Client and Provider can dynamically decide to exchange resources, with limited overhead, and fast deployment. The price can depend on the market.	Several projects have their SL Negotiation component: • AssessGrid • WSAG4j • GRIA • GRASP
SLA Resource Optimisation	BEinGRID SLA Resource Optimisation for GT4	The provider is capable of adapting his resources to the demand, which means making more profit by augmenting the efficiency	No other software proposes to adapt scheduler plannings to incoming SLAs.
SLA Accounting	BEinGRID SLA Accounting for GT4	The provider has control over the execution of the job, and there is finer control at the time of billing the client	There exist very many specialised software in producing reports of consumption of resources in the general acceptation of the term, but none makes the link between SLAs and charging.

The scenario can be extended to use security, data management and portal functionalities. This has been mentioned, and could possibly be the future directions of the research.

Annex A. License conditions

This is a public deliverable that is provided to the community under the license Attribution-NoDerivs 2.5 defined by creative commons http://www.creativecommons.org

This license allows you to

to copy, distribute, display, and perform the work

to make commercial use of the work

Under the following conditions:

Attribution. You must attribute the work by indicating that this work originated from the IST-BEinGRID project and has been partially funded by the European Commission under contract number IST – 034702

No Derivative Works. You may not alter, transform, or build upon this work without explicit permission of the consortium

For any reuse or distribution, you must make clear to others the license terms of this work.

Any of these conditions can be waived if you get permission from the copyright holder.

This is a human-readable summary of the Legal Code below:

License

THE WORK (AS DEFINED BELOW) IS PROVIDED UNDER THE TERMS OF THIS CREATIVE COMMONS PUBLIC LICENSE ("CCPL" OR "LICENSE"). THE WORK IS PROTECTED BY COPYRIGHT AND/OR OTHER APPLICABLE LAW. ANY USE OF THE WORK OTHER THAN AS AUTHORIZED UNDER THIS LICENSE OR COPYRIGHT LAW IS PROHIBITED. BY EXERCISING ANY RIGHTS TO THE WORK PROVIDED HERE, YOU ACCEPT AND AGREE TO BE BOUND BY THE TERMS OF THIS LICENSE. THE LICENSOR GRANTS YOU THE RIGHTS CONTAINED HERE IN CONSIDERATION OF YOUR ACCEPTANCE OF SUCH TERMS AND CONDITIONS.

1. Definitions

"Collective Work" means a work, such as a periodical issue, anthology or encyclopedia, in which the Work in its entirety in unmodified form, along with a number of other contributions, constituting separate and independent works in themselves, are assembled into a collective whole. A work that constitutes a Collective Work will not be considered a Derivative Work (as defined below) for the purposes of this License.

"Derivative Work" means a work based upon the Work or upon the Work and other pre-existing works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which the Work may be recast, transformed, or adapted, except that a work that constitutes a Collective Work will not be considered a Derivative Work for the purpose of this License. For the avoidance of doubt, where the Work is a musical composition or sound recording, the synchronization of the Work in timed-relation with a moving image ("synching") will be considered a Derivative Work for the purpose of this License.

"Licensor" means all partners of the BEinGRID consortium that have participated in the production of this text

"Original Author" means the individual or entity who created the Work.

"Work" means the copyrightable work of authorship offered under the terms of this License.

"You" means an individual or entity exercising rights under this License who has not previously violated the terms of this License with respect to the Work, or who has received express permission from the Licensor to exercise rights under this License despite a previous violation.

2. Fair Use Rights. Nothing in this license is intended to reduce, limit, or restrict any rights arising from fair use, first sale or other limitations on the exclusive rights of the copyright owner under copyright law or other applicable laws.

3. License Grant. Subject to the terms and conditions of this License, Licensor hereby grants You a worldwide, royalty-free, non-exclusive, perpetual (for the duration of the applicable copyright) license to exercise the rights in the Work as stated below:

to reproduce the Work, to incorporate the Work into one or more Collective Works, and to reproduce the Work as incorporated in the Collective Works;

to distribute copies or phonorecords of, display publicly, perform publicly, and perform publicly by means of a digital audio transmission the Work including as incorporated in Collective Works.

For the avoidance of doubt, where the work is a musical composition:

Performance Royalties Under Blanket Licenses. Licensor waives the exclusive right to collect, whether individually or via a performance rights society (e.g. ASCAP, BMI, SESAC), royalties for the public performance or public digital performance (e.g. webcast) of the Work.

Mechanical Rights and Statutory Royalties. Licensor waives the exclusive right to collect, whether individually or via a music rights society or designated agent (e.g. Harry Fox Agency), royalties for any phonorecord You create from the Work ("cover version") and distribute, subject to the compulsory license created by 17 USC Section 115 of the US Copyright Act (or the equivalent in other jurisdictions).

Webcasting Rights and Statutory Royalties. For the avoidance of doubt, where the Work is a sound recording, Licensor waives the exclusive right to collect, whether individually or via a performance-rights society (e.g. SoundExchange), royalties for the public digital performance (e.g. webcast) of the Work, subject to the compulsory license created by 17 USC Section 114 of the US Copyright Act (or the equivalent in other jurisdictions).

The above rights may be exercised in all media and formats whether now known or hereafter devised. The above rights include the right to make such modifications as are technically necessary to exercise the rights in other media and formats, but otherwise you have no rights to make Derivative Works. All rights not expressly granted by Licensor are hereby reserved.

4. Restrictions. The license granted in Section 3 above is expressly made subject to and limited by the following restrictions:

You may distribute, publicly display, publicly perform, or publicly digitally perform the Work only under the terms of this License, and You must include a copy of, or the Uniform Resource Identifier for, this License with every copy or phonorecord of the Work You distribute, publicly display, publicly perform, or publicly digitally perform. You may not offer or impose any terms on the Work that alter or restrict the terms of this License or the recipients' exercise of the rights granted hereunder. You may not sublicense the Work. You must keep intact all notices that refer to this License and to the disclaimer of warranties. You may not distribute, publicly display, publicly perform, or publicly digitally perform the Work with any technological measures that control access or use of the Work in a manner inconsistent with the terms of this License Agreement. The above applies to the Work as incorporated in a Collective Work, but this does not require the Collective Work apart from the Work itself to be made subject to the terms of this License. If You create a Collective Work, upon notice from any Licensor You must, to the extent practicable, remove from the Collective Work any credit as required by clause 4(b), as requested.

If you distribute, publicly display, publicly perform, or publicly digitally perform the Work or Collective Works, You must keep intact all copyright notices for the Work and provide, reasonable to the medium or means You are utilizing: (i) the name of the Original Author (or pseudonym, if applicable) if supplied, and/or (ii) if the Original Author and/or Licensor designate another party or parties (e.g. a sponsor institute, publishing entity, journal) for attribution in Licensor's copyright notice, terms of service or by other reasonable means, the name of such party or parties; the title of the Work if supplied; and to the extent reasonably practicable, the Uniform Resource Identifier, if any, that Licensor specifies to be associated with the Work, unless such URI does not refer to the copyright notice or licensing information for the Work. Such credit may be implemented in any reasonable manner; provided, however, that in the case of a Collective Work, at a minimum such credit will appear where any other comparable authorship credit appears and in a manner at least as prominent as such other comparable authorship credit.

5. Representations, Warranties and Disclaimer. UNLESS OTHERWISE MUTUALLY AGREED TO BY THE PARTIES IN WRITING, LICENSOR OFFERS THE WORK AS-IS AND MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND CONCERNING THE MATERIALS, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, MERCHANTIBILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT, OR THE ABSENCE OF LATENT OR OTHER DEFECTS, ACCURACY, OR THE PRESENCE OF ABSENCE OF ERRORS, WHETHER OR NOT DISCOVERABLE. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO SUCH EXCLUSION MAY NOT APPLY TO YOU.

6. Limitation on Liability. EXCEPT TO THE EXTENT REQUIRED BY APPLICABLE LAW, IN NO EVENT WILL LICENSOR BE LIABLE TO YOU ON ANY LEGAL THEORY FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES ARISING OUT OF THIS LICENSE OR THE USE OF THE WORK, EVEN IF LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

7. Termination

This License and the rights granted hereunder will terminate automatically upon any breach by You of the terms of this License. Individuals or entities who have received Collective Works from You under this License, however, will not have their licenses terminated provided such individuals or entities remain in full compliance with those licenses. Sections 1, 2, 5, 6, 7, and 8 will survive any termination of this License.

Subject to the above terms and conditions, the license granted here is perpetual (for the duration of the applicable copyright in the Work). Notwithstanding the above, Licensor reserves the right to release the Work under different license terms or to stop distributing the Work at any time; provided, however that any such election will not serve to withdraw this License (or any other license that has been, or is required to be, granted under the terms of this License), and this License will continue in full force and effect unless terminated as stated above.

8. Miscellaneous

Each time You distribute or publicly digitally perform the Work, the Licensor offers to the recipient a license to the Work on the same terms and conditions as the license granted to You under this License.

If any provision of this License is invalid or unenforceable under applicable law, it shall not affect the validity or enforceability of the remainder of the terms of this License, and without further action by the parties to this agreement, such provision shall be

reformed to the minimum extent necessary to make such provision valid and enforceable.

No term or provision of this License shall be deemed waived and no breach consented to unless such waiver or consent shall be in writing and signed by the party to be charged with such waiver or consent.

This License constitutes the entire agreement between the parties with respect to the Work licensed here. There are no understandings, agreements or representations with respect to the Work not specified here. Licensor shall not be bound by any additional provisions that may appear in any communication from You. This License may not be modified without the mutual written agreement of the Licensor and You.