Greed Manifesto

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0 Document status

v1.0, Oct–Dec 2007. Initial version intended for friends. Presents a dream of the Greed project and wanders off into the realms of eventual possibilities.

v1.0.1, 20 Jan 2008. Incorporated comments from Jan Jona.

v1.1.0, 16 Nov 2008. Remove section *"Technological overview"* and *"Work-plan towards minimal implementation"*. They are now available from the web – as they should really be discussed further.

1 Introduction

Greed is a vehicle for dissemination and universal exploitation of scientific and educational programs. It combines the concepts of `grid`, `computing@home` and massive multi-player online games with the *free and open-source software* ideology and development practices. The main aim of Greed is to become a link between institutions for research & education and Internet users by providing a global and open computing environment that allows all parties to pursue their own goals and interests. Institutions utilize the computing resources of Internet users and in return provide a high-reliability server infrastructure needed for operation of persistent virtual worlds created and maintained by communities of Greed members.

In its essence, Greed is a hack to make this world a better place. It attempts to expose greed both as the ultimate source of motivation as well as an unwholesome tendency that limits the human cooperation and hinders global development. But greed is not a very good name for a project, unless it is an acronym: Greed is a *Global Research Environment for Equitable Development*.[1]

2 Roots of the Greed initiative

Every global initiative starts with a concrete problem and with a vision of how the present elements can be combined for the common good. Greed is no exception to this rule: it is motivated by the computing needs of the *Large Hadron Collider* (LHC) experiments and by the desire of its individual members to expose the computing technologies developed for operation of LHC and use them as an outreach stunt for popularization of scientific theories and contemporary technological endeavors undertaken for their exploration.

While the basic computing requirements of the LHC experiments are covered by the dedicated infrastructure of the LHC computing `grid`, there is little spare capacity for advanced

[1] *Global Research Environment for Eidetic Design* is also an option, suggestions are welcome.

searches for exotic particles and new physics which require significant computing resources, mainly in terms of event simulation and analysis of both simulated and real experiment data.[2] The additional computing resources provided by the public at large could thus contribute the final stone to the full exploitation of the physics potential of the LHC.

As the full experiment software and accompanying data would have to be distributed for the operation of such infrastructure, it would also become feasible for anybody to run simple data visualization and analysis applications allowing better understanding of the LHC project, of the LHC experiments and of high-energy physics in general. This is of particular interest for universities and high-schools as the programs could be used for student projects or for exercises in physics, computing and statistics. Additionally, educational institutions usually own a fair number of computers (desktops in offices and computing rooms) that are only utilized half of the time as well as have a reasonable WAN up-link and can thus also offer CPU power for utilization by the LHC experiments.

On the other side of the equation we have 1.2 billion Internet users that we want to inform about and engage in the latest scientific and technological developments in an attractive and accessible manner. This calls for an analysis of the possible user base, keeping in mind that another purpose of the GREED is to harvest the computing resources of its target audience for scientific computation.

2.1 Possible audiences of the Greed

The success of several `computing@home` projects during the last five years[3] points to a surprisingly high level of interest for scientific computing present among the general public. The basic terms of contract between the users and the project seem, in most cases, deceptively simple. The project provides a computing platform and a basic community portal that often consists mostly of expert-level information (references to scientific papers or research laboratory web-pages). Based on this rudimentary infrastructure, the users connect into the distributed computing environment, contributing their CPU, disk-space and bandwidth for no apparent benefit. But people who are willing to go through the trouble of installing the computing client and paying for the electricity[4] more than likely care about what they are contributing to, even though this can be any of the following things:

- rational exploitation of existing computing resources;
- development and utilization of cool new software and ideas pertaining to networks, computing and information technologies in general (e.g. FOSS movement, `grid` computing, peer-to-peer computing);
- supporting a specific project due to its perceived scientific or humanitarian merit.

Whatever are the actual motives, the contributors are effectively forming a community and many of them would feel inclined towards investing some of their time into further exploration of the project they are contributing to. The idea of GREED encompasses all of the above motivations and it would almost certainly appeal to the majority of existing contributors.

At this point let us also consider the popularity of community knowledge sites (Wikipedia), of alternate reality worlds (SecondLife) and of massive multi-player online games (World of

[2]The resources provided to the ALICE experiment during the first four years of the detector operation are actually significantly below the pledged level.

[3]Currently folding@home is the most active one. In Dec 2007 it passed the tera-flop mark with 500k registered users. During year 2007 PS3 clients accounted for a better part of the project's growth.

[4]Estimating power consuption to 100W per core, the monthly consumption is 48kWh. For France this makes about 6.5 EUR per month per core.

Warcraft, EVE Online). Most of the services in the last two categories also require a subscription with monthly charges up to 25$. There are two common attributes of users who participate in these activities that also make them possible GREED contributors:

- they have a PC with Internet access and use it as a communication engine, as a hobby, or simply for fun;
- they spend significant amounts of their time online and are willing to contribute their work or effort to the community.

The combined user bases of these projects well exceed 20 million people. But unlike the contributors to `computing@home` projects, the users of these community-engines do not have a common set of motives. Thus either a sub-set of of users needs to be selected or, alternatively, a variety of strategies need to be employed to arouse the interest of as many users as possible.

To summarize, there are many existing activities on the Internet that provided aspiration for GREED. One could even say that GREED is a peculiar combination of elements from the projects mentioned in this section that have not been placed into a common context yet.

2.2 High-level description of Greed worlds

Persistent multi-user virtual worlds have been chosen as the primary means of dissemination because they appeal to a variety of audiences, from primary school level onwards, determined by the complexity and scope of the virtual world elements. To maintain coherency and allow information exchange between different worlds, a common basic world structure must be employed. It should be general enough to allow a multitude of scientific and technological elements to be combined into coherent worlds of different characters. At the same time, within the mechanics of each such world, it must be possible for users to participate in the world development on completely different levels of engagement and personal time investment.

To achieve that, the worlds are presentable on different levels. Each presentation offers a specific view of the world and offers a specialized user interface for interaction with the presented world elements.

- *Strategic* view provides insight into relations among entities on a large-scale by presenting status and activity of large, compound world entities and their communications. This information can be combined with maps or diagrams of extensive sections of space, like galactic regions, solar or planetary systems, or individual planets. When presenting a specific element, e.g., production, distribution and consumption of a valuable resource, the relation among contributing entities can be visualized as a 3-dimensional graph, supplemented by histograms, plots and tables. High-level settings can be changed here, affecting a multitude of entities by effectively altering the parameters of world development algorithms.
- *Operational* view focuses on specific tasks or on relations among entities in a more local context. For example, this view would be used for planning and execution of a resource-discovery mission followed by construction of resource-extraction and transport facilities. Settings from the operational level influence a specific group of entities via interaction with the control agents, not with the individual entities. As above, map and 3D-graph views can be employed. In this mode it is also possible to use an immersive 3D-view, augmented with overlays of schematic data.
- *Tactical* view presents environment and world entities in detail and allows management of individual entities by assigning them specific tasks or control agents. Map and augmented 3D views are used here, possibly accompanied by a radar-like view of the operational area.

- *Entity* view focuses on different aspects of control over an individual entity. This ranges from first-person view and operation of a vehicle or a space-ship to control over production parameters of a factory or laboratory.

Strategic and operational views can focus on different world aspects, e.g., on transport routes, on energy acquisition and distribution networks, on world exploration and surveillance, or on progress in science and engineering.

The initial layout of the virtual worlds follows the structure of a solar system[5] and prompts users to engage in exploration, resource acquisition, infrastructure construction and research activities by controlling the in-world entities. The initial time is set about 20 years into the future, with reasonably extrapolated technologies and with the addition of two new fictitious technologies: the quark-gluon plasma reactor and the Higgs-field driven vacuum polarization chamber, both spin-offs of the LHC project, allowing construction of a new generation of extreme energy sources, control over large-scale quantum coherence and rudimentary manipulation of the space-time continuum.

To underline the fragility of our civilization, the story could begin with a cataclysm: human population of Earth is decimated by a global disaster (caused by biological agents, comet impact, or global redefinition of weather patterns) and the survivors are in position to operate robotic factories and agents. The resources from Earth and Moon are used to build Foundation vessels that are sent through poorly controlled wormholes into random solar systems of our universe where they have to bootstrap new civilizations. Of course, the users themselves will determine for each individual world if its further development will be carried out in a cooperative or in an opposing manner.

Humans are a scarce and vulnerable resource in these conditions, vitally needed for scientific and technological development as well as for operation, maintenance and upgrades of existing technological units. The human population dynamics and living conditions of the humans determine the number of skilled scientists and engineers that are produced within each simulated community and become available as controllable world entities.

To actively employ such a specialist, the user must also spend *research credits* that can only be gained by providing computing resources to Greed institutions. Alternatively, some research credit can also be gained via online quizzes where a user is given a specific data-set on which he must perform data-analysis and correctly reply to a set of questions. The virtual-world research cost needed to achieve major scientific and technological breakthroughs far exceeds the computing resources of a single user, thus forcing the users to form cooperative communities.

Introduction of new technologies and research paths is determined both by the world maintainers and by the users' communities. Users implicitly provide the development preferences by concentrating their effort on specific areas while the world maintainers need to provide adequate scientific and technological improvements. New technologies will inevitably also introduce new world entities and provide new requirements for extensions of the world mechanics. At this point the developers of the core framework and world steering algorithms will have to incorporate the new technology into the system and make sure that it functions consistently with the existing world elements.

The in-world technologies introduced in the future will eventually allow controlled long-range space travel, leading to possibilities for further exploration and colonization as well as for establishment of connections between different worlds, to increased cooperation and possibly to conflict.

[5]Different topologies with similar consequences for the world dynamics are also possible, e.g. *Emental* world consisting of a number of Dyson's spheres connected by a set of stable tubular wormholes.

2.3 Possible extensions of Greed world mechanics

This section presents a review of different research fields that could be introduced into Greed worlds either to increase their level of detail or to imbue them with realistic scientific models and knowledge databases. In this way Greed can provide a virtual environment that is based on the latest research results and can be directly used not only as a tool for teaching and for individual exploration of recorded knowledge but also as an engine for simulation of complex systems. In this spirit it is hoped that other research institutions and projects will join the Greed initiative by providing their knowledge, manpower and server infrastructure to receive the benefits of user-provided CPU power and popularize their field of expertise among the general public.

Astronomy and cosmology strive for the understanding of the universe and of all the phenomena that proceed within it on a wide range of spacetime-scales. It is therefore necessary to include the astronomical facts, at least at a basic level, into the world mechanics from the very beginning. With the interest from the astro-physics community, detailed knowledge about universe could be incorporated into the world mechanics, from realistic taxonomy and composition of solar and planetary systems to large-scale structure of galaxies, galactic clusters and beyond.

General theory of relativity plays an important role in the simulation of long-range space travel and in presentation of exotic astronomic phenomena while quantum mechanics and nanotechnology present the basic sciences for future technological development. Additionally, hypothetical couplings between general relativity and quantum mechanics could be stipulated and explored in semi-realistic technological contexts leading to, for example, faster then light travel and space-time manipulation devices.

Many disciplines of computer science naturally permeate all elements of the world simulation software and of distributed information services required for world operation and maintenance. Staying within the aspects of the world mechanics and presentation, the most important fields are computer graphics, computer vision, robotics, artificial intelligence and control of autonomous agents. All of them can be employed on both sides of the world, by the users to steer their development and by the world maintainers to control non-interactive world entities.

Resource acquisition, resource processing and industrial production can be simulated by various aspects of geology, metallurgy, chemistry, material science, engineering and process control. Futuro-realistic simulation of energy generation and consumption provides an interesting platform for exploration of alternative energy sources, energy storage technologies and conversion devices. Construction and operation of infrastructure, habitats and transport vehicles depends on all of these disciplines, thus allowing the introduction of complex world constructs, mechanisms and constraints.

Distribution of resources on the level of planetary and solar systems determines the location of initial settlements and leads, as technology progresses, to the need for safe and energy-efficient transportation of raw-materials, products and world entities among different communities. Trade and other forms of economic cooperation naturally arise in such circumstances, adding a new level of activity into the world mechanics. Of course, technology, knowledge and expertise can likewise become the objects of trade.

Management of human population initially starts with a basic population dynamics. As human specialists play an important role in research, engineering and process control, the main emphasis is put on education and general well being of human communities. Cultural aspects can be introduced from two sides, from the direction of the individual and from the direction of the society. In the first case art and philosophy influence the possibilities of individuals for attainment of knowledge, expertise and wisdom. In the second case, human liberties, moral values, ideologies and religions determine the level of social coercion and define the possible

scope of social manifestations as well as of reactions of an individual to the imposed conditions. In an extreme case, these models could be used to explore alternative forms of government, social solidarity and economic relations with the goal of increasing human prosperity, stimulating the growth of knowledge and maximizing the rate of technological development.

2.4 Levels of realism in Greed worlds

Combination of all the above elements obviously leads to a world that is overly complex and, as it seems at the moment, quite impossible to construct and to maintain. While this remains the final goal, it seems a sound tactics to start with several disparate worlds that are constructed from a subset of carefully selected elements, chosen by considering several aspects of the world simulation.

- *Scope and detail of scientific, technological and sociological elements* determines the active world mechanisms and sets the main roles available to users.
- *Intended public* directly influences the complexity of both the simulated world and world mechanisms.
- *Spatial extent, duration and tempo* pose the requirements for the server infrastructure. They also determine the amount of time users must invest into the interaction with the world to accomplish sizable advancement.

Users' feedback and interest in actual running worlds will help to determine what types of worlds are of interest for different audiences and will further influence the development of core world simulation framework.

Basic worlds are built around a small number of basic elements. The world duration ranges from hours to weeks, the spatial extent is limited accordingly. They have three main uses:

1. worlds for new users that need to gain initial understanding of the world mechanisms and concepts or want to explore a new type of world;
2. worlds with content and complexity suitable for children (user interface can be simplified to the level of simple computer games); and
3. testing of new world mechanisms and their balancing against existing elements.

As these worlds are relatively short-lived, they can be regularly tailored to serve the changing needs of the community.

Intermediate worlds combine more elements on a higher level of detail and their duration ranges from months to years. These worlds can focus on a variety of topics from the repertoire described in previous sections and only experimentation can show which areas will attract most users. As the chosen emphasis also determines the level of users' engagement, several different worlds will be needed to cover the expectations of individual users.

Realistic worlds with all available complexity in certain field can be used by specialists for testing of real-world algorithms, for development of AI agents and for simulations of space exploration missions. By keeping the user interface consistent with the one of intermediate worlds, the users can intuitively enter them to gain insight into current research or use them as a knowledge data-base system.

2.5 Conclusion

Due to the multitude of directions the development might take, it seems pointless to consider the final structure and content of the worlds in a more detailed manner. However, it is important that the actual flow of development remains influenced by world creators and users alike, allowing all parties to remain satisfied with the contract.

3 The Greed partnership

The GREED partnership is formed among two main parties: the research institutions and the Internet users, with GREED as an organization playing the role of the middle man. Initially, GREED will take a form of a virtual organization for popularization of science and technology with strong emphasis on dissemination of contemporary information technologies used in advanced research environments, particularly in the HEP community. With time it can become a non-profit organization with the eventual income being spent for further development of GREED worlds, for maintenance of existing infrastructure and for financing of projects related to spreading of universal scientific education.

This section analyzes benefits and concessions of different parties that can join the GREED partnership. All these are, at the end, a question of subjective rationalization: some seem realistic and sound while others don't have any appeal at all. Therefore, let thousand flowers bloom, let every ear hear its story.

3.1 Internet users / General public

Benefits:

- Participation in GREED worlds and communities.
- Access to knowledge data-bases.
- Understanding of contemporary research activities and technology.
- Long-term benefits of increased public interest in scientific development and universal education. This is, in fact, the ultimate motive of the GREED project.

Possible concessions:

- CPU power, disk, bandwidth.
- Involvement in world creation and world maintenance.
- Work for individual sub-projects (core development, art-work[6], or community support).

3.2 Institutions for research and higher education

Benefits:

- Distributed computing environment and resources for execution of simulations and analyses with high demand for computing resources.
- GREED worlds provide an environment for construction of complex knowledge models and databases that can be utilized and presented on different levels. They can be used for research, knowledge preservation and for educational purposes.
- Popularization of individual areas of science by exposing scientific models and current research via GREED world mechanisms and databases.

[6] E.g., textures, 3D models, animations, sound effects, music, or story-telling.

Possible concessions:

- Computing resources for other projects. These resources can be claimed back from other GREED members when the need arises.
- Servers for running of GREED worlds and storage of world data.
- Partake in GREED software development; provide developers for core GREED environment or for specific extensions of world mechanicsms and knowledge databases.

3.3 Commercial corporations

Until now, commercial corporations have not been mentioned as possible members of the GREED partnership. As GREED is, in its essence, a public welfare project, sponsorship from corporations could be expected at some basic level. However, there is a possibility for a far more specific interest of corporations: advertising. Not only could the advertisements be placed on the sites of GREED worlds as they are placed on more and more community portals, they could also be actively introduced as world entities, e.g., Airbus / Boeing space-ships, Hyundai vehicles, or Novartis life extension drugs. To prevent complete commercialization of GREED, the participation of commercial entities should be restricted to a subset of worlds that offer additional benefits to the users in exchange for being targets of advertising campaigns.

Benefits:

- Advertising, in both senses mentioned above. First, specific product placement through advertising on community sites, and, second, boosting brand and trademark recognition through in-world products or entities.
- Image building by presentation of technological vision or display of interest for general progression of technology and science.

Possible concessions:

- Financial support for specific projects or GREED maintenance.
- Provision of computing resources for operation of GREED worlds.
- Sponsoring user groups that tie themselves to an interest that is close to company's spirit.
- Providing in-world or real-world rewards for users that meet certain criteria or deliver best solutions to calls for creation and improvement of in world entities or mechanisms.

In-game advertising of real-world products and brands has been used in several titles since the mid-90's. Significant income started to be gained during the last few years, with the ability to deliver targeted dynamic advertisements into the on-line virtual worlds and games.

3.4 Conclusion

There are many appeals in the GREED project for all three parties discussed in this section. A careful analysis confronting the expected manpower investment against public interest it is expected to arouse should be made in order to determine the best strategy for placement of specific options for contribution and benefit of individual parties. When preparing a public version of this document, the focus must be known quite specifically and document's structure revised accordingly.

4 Closing remarks

In its essence, this document is an invitation to join in early discussions about GREED, its basic premises and its possible evolutions. A more concrete technological overview and a proposal towards the prototype implementation is available on the web.[7] A community site for wider audience is also being prepared.[8]

It is too early to plan the details and assign commitments. But it is the right time to consider the possibilities of GREED in the present reality and to ponder whether the project could fly, regardless what final form it might take.

[7] `http://www.gled.org/docs/greed-design-docs/greed-tech-workplan.html`
[8] `http://greed.gled.org/`

A Definitions

Greed@home Sub-project of GREED that harvests the computing resources of Internet users.

Greed members Internet users, research institutions, GREED world developers and commercial corporations that willfully join the GREED partnership.

Greed users Internet users that contribute their computing resources and participate in GREED worlds.

Greed-world Sub-project of GREED for creation, maintenance and operation of virtual worlds available to GREED members.

Greed worlds Virtual worlds simulating scientific and technological exploration of different universes, ranging from completely imaginary ones to those that attempt to mimic our reality.

world elements Stars, planets, entities, resources, infrastructure, technologies, algorithms.

world entities Physical world objects like terrain structures, buildings, factories, laboratories, vehicles, AI agents and human specialists. Users can interact with them and influence their future state or actions.

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