

ASTRIC: Cooperative modular robotic network for space debris operations

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Abstract

The Planetary Defense Network (PDN) is a system of permanent satellites and human-inhabited space stations that are located in geostationary orbit around Earth. The primary function of the PDN is to provide space-based rapid response to mitigate threats to inhabitants of Earth and other space-based habitations near Earth such as on the Moon or in other orbital space stations, employing a variety of technologies including the ASTRIC robotic ensembles that can deliver a variety of responses including mechanical intervention and manipulation of objects such as asteroids and comets and non-mechanical intervention in the case of select other threats such as solar electromagnetic pulse events (EMP).

The first discussions and exploratory initiatives for a PDN began in the early 1990s among a small group of scientists and experts in several disciplines, all of whom were individuals from the United States and Russia.

ASTRIC is described elsewhere. The fundamental ASTRIC systems engineering design consists of a multi-function system of constructors, built from six classes of modules, operating as cooperative groups of robots, each unit performing its tasks under either autonomous, semi-autonomous, or full-human-operator control. The primary function of the first ASTRIC system is for asteroid operations including asteroid trajectory modification (deflection) in order to eliminate an impact collision with Earth. Other functions can and will be later accommodated, including other construction and assembly tasks both in space (typically in orbit around some body) and on surfaces (typically lunar or asteroid).

Planetary Defense Network (PDN)

This is a distinct and quasi-separate project initiated by ASTRA Institute and involving a number of collaborators, partners, sponsors and advocates from many different fields and areas of study and profession. It is very directly related to the specific purposes and functions of ASTRIC and to other topics concerning large-scale, very-long-term projects concerning space and also environment, including many central concerns and tasks on Earth. This extends far beyond “STEM” and is a very bold initiative with many challenges. However, it is now considered to be a fundamental goal of the ASTRA Institute and other partners, supporters and advocates with similar concerns. Although ASTRIC fundamentally does not depend upon this PDN, they fit together and belong together.

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Planetary Defense is a very significant and constant concern for all humans on Earth. Moreover, as humans begin to expand through colonization onto the Moon and other planets, and eventually beyond the solar system, these concerns will not only remain but multiply. There are many risk-opportunity situations for which Planetary Defense is an imperative which cannot be ignored and must be addressed and implemented.

Three major risks, which can and should also be seen as opportunities, include:

<u>Condition/situation</u>	<u>Risks</u>	<u>Opportunities</u>
asteroids	<ul style="list-style-type: none"> ● impact with Earth or other human habitation 	<ul style="list-style-type: none"> ● mining, construction, habitation, use in orbital energy systems
solar EMP	<ul style="list-style-type: none"> ● catastrophic EMP effect upon Earth or other human habitation affecting entire techno-infrastructures 	<ul style="list-style-type: none"> ● deflection or other mitigation of solar-wind drafts and potential conversion or use of the EMP to other purposes in space and away from human habitation sites
energy grid on Earth	<ul style="list-style-type: none"> ● insufficient “clean” energy generation on the planet 	<ul style="list-style-type: none"> ● energy generation in orbital space from solar and nuclear-power sources with beaming of energy in mm-wave form to Earth for use within energy infrastructure

Two “outlier” risks, for which the PDN could potentially serve value, are also presented here, but these are clearly outliers in terms of either the events happening, or there being sufficient technological means to have any useful effect by the PDN (or any other system).

gamma ray burst	<ul style="list-style-type: none"> ● catastrophic effects for all biological life, particularly humans and other mammals ● deflection of critical-intensity bursts
degradation of Earth's magnetic field	<ul style="list-style-type: none"> ● increased sensitivity of planet's surface to variety of EM radiation from sun/other ● creation of artificial EM barrier/shield, a synthetic “van Allen belt”

PDN involves a very “radical” plan from the perspective of society, nations, politics, and the current climate of how humans, as societies and specifically as nation-states, interact and operate with one another on the global stage of Earth and also in Space.

PDN has a long history that predates ASTRA Institute and even the lifespans of anyone connected to ASTRA or ASTRIC, or anyone currently alive on Earth, but it has a strong and memorable beginning in the early 1990s which involved several scientists, some well-known and others not so, and particularly from two nation-states: USA and Russia (and the former Soviet Union).

PDN is not only about protecting and defending Earth (and other human habitations beyond Earth, both in orbit, on the Moon, and potentially elsewhere) from objects or forces coming from “somewhere, far beyond, in space” that are risks to life, such as asteroids or solar EMP.

PDN is also very, very much about defending Earth and all organized human life and civilization from – ourselves, we humans, our nation-states and our risk of total annihilation through nuclear war.

The Planetary Defense Network consists of the following:

A two-site space station complex, constructed at an appropriate geostationary orbit (e.g., L5) above Earth. One site is the operations center, inhabited. The other is the repository of nuclear explosive and propulsive devices, both fission and fusion, many different types, as a stockpile, ready for configuration, loading, assembly, and activation within a variety of machines, most of which may be rocket-type carriers, and also robots that will themselves be transported by various carriers (typically also, in today's current technology level, rockets of one form or another). These comprise the explosive and propulsive devices to be used in a variety of ASTRIC-type operations, and other procedures that may be as simple as "point-launch-detonate" operations, which serve in one form or another to defend Earth (and other human habitations such as on the Moon) from various risks, and/or to perform constructive tasks that may require use of such nuclear devices (e.g., some forms of lunar or asteroid mining).

One of the paramount applications is in the reduction of an asteroid impact threat in a case where the asteroid is sufficiently large in mass that other ASTRIC methods (multi-point tethering (the basic and primary ASTRIC mechanism), ballistics, gravity tractors, and other non-nuclear means) will not be capable of performing the desired trajectory deflection. (The asteroid 99941 Apophis may be one example of such an asteroid, posing a threat and being too massive for other ASTRIC methods to be employed reliably.)

With an array of nuclear explosive devices located in deep space at the PDN base, there is a further very important counterpart pertaining directly to Earth and all its human inhabitants. By firm irrevocable international agreement, consisting of a Permanent and Universal Global Treaty, which can aptly be named the SOUL Treaty ("SOUL" = Survival of Organized Human Life), there will be no nuclear weapons of any form, neither fission-based or fusion-based, maintained or constructed on Earth. All nuclear weapons (warheads, devices) not used by redirection, transport and re-engineering within the PDN in deep space, will be summarily deactivated and disassembled by their respective nation-state owners.

Zero nuclear war on Planet Earth.

Total deployment of nuclear fission and fusion for only controlled purposes on Earth (e.g., generation of electric power, or conceivably under special circumstances for deep-underground construction), and for use by the PDN for the protection of Earth and other human habitations.

Zero nuclear weapons on Planet Earth.

The PDN will be a neutral non-political organization, answerable to all and to none, in the sense that it is not under the control of any one nation-state or group of such states, nor under the control of any present organization such as the United Nations. The PDN is fully and totally autonomous, operating under a council of governors responsible for all decisions concerning all PDN operations, including the use of its defensive arsenal of ballistics that are at the deep-space base.

The Council of Governors of the Planetary Defense Network

The Council will be established by a process that involves many groups and types of people from around the world. This will certainly involve the inputs by different nation-state leaderships such as governments, but it will also involve the inputs from scientific, technical, medical, and social leaderships, and overall, the full body of humans will have opportunities for valid and valued input into how the Council is organized and who are its members and how they will govern the operations of the PDN. There will also be sufficient but controlled use of synthetic intelligence (SI, "AI") systems that have been implemented, also under the guidance and supervision of many appropriate groups within society – with sufficient fail-safe mechanisms constructed to eliminate the possibilities of misuse – in order to assist and to provide important check-and-balance mechanisms that will further prevent misuse of anything involving the PDN and its technical powers.

The membership of the Council will include persons who will be resident, for various periods, at the PDN base in space, while others are resident at other locations (typically on Earth). As part of the mechanism for elimination of conflicts of interest and corruption, all serving members of the Council will live by personal lifestyle principles and rules that aid in preventing such incidents and consequences. These guidelines and rules will be defined in the process of establishing the Council.³

The intention now is to generate visibility, attention, support, and influence, for ASTRIC and in parallel, for the PDN, first and foremost through the private sector, and then working upon those persons and agencies as required to achieve support from the public sector.

[This completes the points in this summary document.]

³ There are excellent foundations for the Council's lifestyle rules: among others of value, there are these: "Republic" (Plato), "Politics" (Aristotle), and the guidelines of Christian, Judaic, Islamic, Buddhist, Hindu, Taoist, Confucian and other faiths and philosophies. There have been ample guidelines, for how to ensure that the Council does not become corrupt and perform antithetical actions, coming from over 4,000 years of written human history.