

Sustainable Space Colony Swarm Architecture

A SPACE COLONY AND ITS SUPPORTING SWARM ARCHITECTURE

Basic principles & preconditions

Main focus

- the needs and goals of people
- sufficient room and the natural habitat that our body and mind needs
- with a sufficiently large population, with a large variety in ages, types of people and skills extensively supported on many levels

Holistic approach

- multi-layer architecture

Safe & robust

- artificial gravity, radiation protection, atmosphere, water, food and light
- robustness by default:
 - compartmentalization,
 - distributed implementation,
 - multilayer redundancy with fallback,
 - backup facilities & resources
 - impact and collision prevention

Mindset

- either safe or not, with regular internal and external evacuation drills

Sustainable

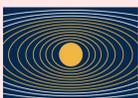
- solar energy unless
- reuse physical resources (building, equipment, parts, air, food, water,...)

Autonomous

- and self-supporting stations, segments and modules

Evolutionary approach

- standing on the shoulders of the scientists before us (O'Niell cylinder, Stanford torus, Bishop Ring, McKendree cylinder,...)
- continuing the work of organizations like ESA, NASA, Roscosmos, ISRO and CNSA
- and commercial organizations like Virgin Galactic, Blue Origin and SpaceX



Learn from and mimicking nature

- photosynthesis, self-replication, symbiotic mutualism, multi-layer collaborative networks

International cooperation is a prerequisite

- using the power of economy and business, the power of collaboration, standardization and a modular approach

Spirit

- learning and progressing, with optimism and determination,
- agile and flexible, also in development and maintenance,
- assuming e.g. Moore's Law and anticipating great new discoveries and inventions

Global solution

A collaborative network of a space colony and its supporting swarm architecture

With multiple habitats, with support from Earth

support from celestial bodies: Moon, Venus, Mars and Asteroids

support in space: safety, energy, logistics, manufacturing

With a space armada

at Lagrangian points: clouds of space stations, with settlements, manufacturing, energy supply and science stations

around that cloud a protecting swarm and a generic logistics fleet

Safety and Security Services

Collision Prevention Services

- for object impact defense, mostly autonomous, consisting of multiple types of telescopes
- distributed information and knowledge processing
- flight vector adjustment services, by autonomous unit(s)
- cloud overblow facility

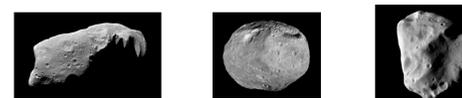
Remote controlled repairs fleet

Environment sustainability services

- for humans, flora and fauna
- air and water purification
- artificial gravity provisioning
- radiation protection
- temperature control
- medical services

Information security

- confidentiality, integrity and availability



Manufacturing Services

Creating, expanding and repairing

on Earth

- initial implementation
- and later special components

on celestial bodies

- permanent settlements on Moon, later on Mars and Asteroids,
- using local resources and raw materials to deliver high-quality building material in form of standard modules

from Venus

- propellant gas from Venus atmosphere

in space

- a manufacturing complex with a harbor for incoming materials and product delivery
- storage space
- manufacturing space
- assembly in absence of gravity and atmosphere
- support facilities
- energy supply
- materials processing and recycling
- ICT
- living quarters



Habitat Services

Multiple permanent residential settlements

starting with 2

- building more, different sizes and shapes, resembling villages

sufficiently large multifarious population

- each 500-1000 people of all ages, plus flora and fauna

sufficient room and the natural habitat

- that the human body and mind needs,

including both individual and shared areas

- for privacy, work and leisure

with a main focus on wellbeing and sustainability

- respecting psychology, spirituality and quality of life

Example form:

a rotating capsule

- of a cylinder of 400 m long, a radius of 80 m,
- half spheres at the endpoints, 3 times 3 spokes and a thick axis,
- surrounded by counter-rotating cylindrical skin layer;
- this could support 1000 people and the cylinder is large enough to prevent motion sickness due to Coriolis forces acting on the inner ear

the skin layer

- containing solar panels, cameras
- a shield with solids (e.g. moon sand), fluids and gasses
- protecting against object impacts and radiation
- power storage, balancing energy demand & supply, among others by using temperature of skin elements and pressure in gas between batteries
- counter-rotating to cancel out and use gyroscopic effects, using wedge-shaped segments in a flexible roof tile layout, for 3D mass distribution adjustment, for adjustment of the gyroscopic effect (wedges in roof tile layout, retaining radiation shielding)

the cylindrical decks layer

- multiple decks with living quarters, work areas, shared spaces and agriculture
- standard dimensions, can be flexibly combined
- with flow of air, water, conduits in floor and/or ceiling, for replenishment, supply and disposal and temperature control
- outermost layer with water and air, for purification, storage and temperature control
- windows in the inner rim looking inwards to the axis, spokes and harbors
- decks expandable to inside

the skin layer and decks layer

- different angular velocity
- separated by electromagnetism
- which is also used to transfer power between layers via induction

the spokes and the axis

- mainly used for science, industry and supporting systems
- central facilities including storage, power processing, chemical processing, IT equipment
- also some manufacturing and repairs, facilitated by the low gravity

the half spheres

- contain docking stations with rails leading to internal harbors
- and with communication arrays

angular rotation

- generated via strategic docking during construction

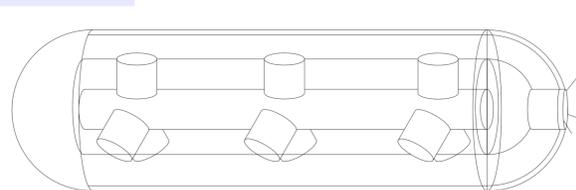
Temporary settlement facilities

also are needed,

- with no or limited artificial gravity
- for temporary work like construction and repair
- but also as emergency escape space for evacuation

Usage and construction

- is modular, flexible and expandable



Energy Services

Abundant energy facilitates

Generation

- default solar, on skins
- in dedicated solar arrays, in space and near settlements
- for robustness and redundancy
- also some chemical and nuclear

Storage

- energy storage
- also using inertia (rotating masses)

Transfer

- energy transfer services
- between containers, wired or contactless
- energy form transfer services (electricity - chemical - nuclear)

Usage

- mainly electricity, gas for propulsion
- modular & replaceable, using standard
- small maneuvering thrusters
- and large replenishable rockets



Coherence Services

Coordination and management

- Physical keep the armada together
- location, movement, solar focus

Communication

- multiple types, robust, redundant, resilient

Collect and share knowledge

Energy balancing

Standards

- architecture
- units
- sizes
- building blocks (module definition)
- connections
- documentation
- quality assurance

Contact

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