

Inclusiveness In the New Space & Protozone Transportation Services

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Diversity of Technical Design Demonstrated in Commercial Space Transportation Concepts to Date

Launch Concept	Organizations (Some of Which Are Now Defunct or Merged)
Lighter than Air Ascender- Ion Engine lift from Dark Sky Station	JP Aerospace, World view and Zero to Infinity
Vertical Takeoff / Vertical landing (VTVL)	Armadillo Aerospace, Blue Origin, JAXA, Masten Aerospace, Lockheed Martin/EADS
Vertical Takeoff / Horizontal Landing (VTHL) at Spaceport	Aera Space Tours, Air Boss, Bristol Space Planes, C & Space, Energia, Lorrey Aerospace, Phoenix & Pre-X by EADS, Space Dev, Space Transportation Corp, Space X, Sub Orbital Corp, Myasishchev Corp. Design Bureau, t/Space, Vela Technologies, Wickman Space and Propulsion
Horizontal Takeoff / Horizontal Landing(HTHL)	Andrews, Scaled Composites, The Spaceship Corporation, Virgin Galactic, XCOR, Project Enterprise by TALIS Institute, DLR, Swiss Propulsion Lab
Tow Launch and Horizontal Landing	Kelly Space Technology
Vertical Launch to LEO from Space Port	Alliant, Inter Orbital Systems Technology, Rocketplane/Kistler, Space HAB, UP Aerospace
Launch to LEO from Jet Plane or Carrier Vehicle Drop	Triton, Stratolauncher, Launcher One (by Virgin Galactic), Stratolaunch

Emerging ProtoZone and New Space Services and their Estimated Market Size-2035

Who Will Provide? Who Will Use? Who Will Regulate?

Supersonic/Hypersonic Flights into the Extreme Stratosphere (Primarily US and European intended service providers today but potential global market demand for passengers – NO DESIGNATED REGULATOR)	\$10-100 Bil/yr
New Low Cost Launch to Orbit (Primarily US, Europe, China, India and Russia intended providers today) (But this service could allow developing countries and commercial entities to enter the space applications field.) e.g. Launcher One, Stratolauncher, etc. (NO DESIGNATED REGULATOR)	\$10 Bil/yr Upward
Space Tourism/ Space Adventures (Primarily US, Europe, and Russia intended providers today) (But global market demand) (NO DESIGNATED REGULATOR)	\$ 2 Bil/yr Plus
High Altitude Platform Systems-Commercial UAVs (Global range of providers-Many developing economy users) (NO DESIGNATED REGULATOR)	\$ 2Bil/yr
Private Space Stations/Habitats – No real space treaty or international regulatory provisions in place. (NO DESIGNATED REGULATOR)	\$1-2 Bil/yr Plus
Proto-Space Robotic Transport (NO DESIGNATED REGULATOR)	\$1 Bil/yr Plus
Dark Sky Station/Ion engine lift to orbit (NO DESIGNATED REGULATOR)	Under \$1 Bil/yr

Issues to Address in New Aerospace Systems

Issue or Facility Involved	Regulatory/Legal Need	Technical Research Need	Int'l Agencies	Additional Concerns	Comment
Airports servicing HTHL spaceplanes	Certification and periodic recertification	Advanced radar & new positioning & navsat software	ICAO	Coordination of regular aviation and space flights	Safety of surrounding area. Liability insurance
Spaceports supporting HTHL, VTHL, VTVL systems	Certification and periodic recertification. Range Safety Control	Advanced radar & new positioning & navsat software	ICAO	Space Traffic Management & Control	Safety of surrounding area. Liability insurance
Launch Sites supporting conventional and commercial rockets	Certification and periodic recertification. Range Safety Control	Advanced radar & new positioning & navsat software	ICAO	Space Traffic Management & Control	Safety of surrounding area. Liability insurance
Rocket Launch from Balloon or Parachute	Range Safety Control and High Altitude Range Control	Advanced radar & new positioning & navsat software	ICAO	Space Traffic Management & Control	Safety of surrounding area. Liability insurance

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Issue or Facility Involved	Regulatory/ Legal Need	Technical Research Need	Int'l Agencies	Additional Concerns	Comment
Rocket Launch from carrier aircraft	Range Safety Control and High Altitude Range Control	Advanced radar & possibly LIDAR systems	ICAO	Space Traffic Management & Control	Safety of surrounding area. Liability insurance
Rocket Launch from ocean	Range Safety Control and High Altitude Range Control	Advanced radar & possibly LIDAR systems	ICAO	Space Traffic Management & Control	Safety of surrounding area. Liability insurance
Ion Engine Craft launched from Dark Sky Station	Range Safety Control and High Altitude Range Control	Stratospheric collisions avoidance systems, Radiation shielding,. Warning Beacons,	ICAO	Space Traffic Management & Control	Liability insurance
Dark Sky Station and Lighter than Air Craft	New types of certification & recertification plus ATC into Stratosphere. Collision avoidance.	. Warning Beacons, Advanced radar & LIDAR	ITU and perhaps WMO and UNEP	Space Traffic Management & Control	Liability insurance

Issues to Address in New Aerospace Systems

Issue or Facility Involved	Regulatory/Legal Need	Technical Research Need	Int'l Agencies	Additional Concerns	Comment
Super Sonic & Hypersonic Transport	Air Traffic Control into Stratosphere	Sonic Boom mitigation standards, Emission standards, Thermal Protection Systems	WMO, UNEP and ITU	Space Traffic Management & Control	Liability provisions, flight path coordination, solar CMEs-flares
Radiation Exposure levels/Health Standards	Radiation Protection Standards, Flight Path Approvals	Ozone hole and Ozone layer investigations	World Health Org., WMO, UNDP	Genetic mutation	Liability provisions, flight path coordination, solar CMEs-flares
Rocket Pollutant Emissions (N0x, Cox, Water Vapor)	Standards for rocket emissions	Stratospheric emission studies. Improved solid propellants (better than aluminum polyimide and neoprene rubber)	WMO. UNDP	Climate Change, Stratospheric pollution	Incentives for improved propellants.
Orbital Debris (Controlled /uncontrolled reentry)	Air Traffic Control and Space Traffic Management	Black boxes for all spacecraft. Warning beacons	UN COPUOS, IADC, SDA	Greater risk of Kessler Syndrome	Fund for debris mitigation. Fines for violations

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Radiation Exposure levels/Health Standards	Radiation Protection Standards, Flight Path Approvals	Ozone hole and Ozone layer investigations	World Health Organization, WMO, UNDP	Genetic mutation	Liability provisions, flight path coordination, solar flares/CMEs
Rocket Pollutant Emissions (NOx, COx, Water Vapor)	Standards for rocket emissions	Stratospheric emission studies. Improved propellants	WMO. UNDP	Climate Change, Stratospheric pollution	Incentives for improved propellants.
Orbital Debris (Controlled and uncontrolled reentry)	Air Traffic Control and Space Traffic Management & Control	Black boxes for all spacecraft. Warning beacons	UN COPUOS, IADC, SDA	Heightened risk with Kessler Syndrome	Fund for debris mitigation. Fines for violations

Issues to Address in New Aerospace Systems

Issue or Facility Involved	Regulatory/ Legal Need	Technical Research Need	Int'l Agencies	Additional Concerns	Comment
Electric Vehicles	Emission Standards and Incentives (Europe is ahead of US here)	Zero polluting aircraft	WMO. UNDP	Incentives for low emission aircraft	Transition planning
UAVs & HAPS and robotic freighters	Air Traffic Control and Space Traffic Management & Control. RF interference	Improved avionics, Emergency override safety systems	ITU	Warning beacons, collision avoidance systems	HAPS and UAVs of prime concern to developing economies
Radio Frequency Interference & allocations	RF Interference from Air & Space Traffic Control & Mgt	Improved Radio systems to avoid interference	ITU	Improved allocations process	Of concern to all countries.

Conclusions

There are a wide range of new systems that need to be considered in terms of air & space traffic management and control – NOT JUST SPACE TOURISM. Frequency allocations, global atmospheric pollution, health standards, are also of concern and ITU, UNEP, WMO, WHO and COPUOS need to be play a role in support of ICAO. Concerns include new low cost commercial orbital launches, private space habitats/platforms, dark sky stations, High Altitude Platform Systems (HAPS), Proto-space or sub-space transport, carrier vehicle or jet drop launches, balloon-based rocket launches, towed launched systems, vertical and horizontal launch and landing systems, commercial sub-orbital flights, and hypersonic transportation systems.

Conclusions (Continued)



For developing economies, some of these services such as High Altitude Platform Systems and Lighter than Air Craft are of much greater concern. Protozone (21km to 100 km) is priority area of concern for all countries and needs to be addressed urgently. Developing countries have a stake in all of this and must be given a role in developing a coordinated new International Air and Space Traffic Control system – based on “model” national regulations that are widely accepted. U.S. FAA and Europe’s EASA and industry groups such as the Commercial Spaceflight Federation, plus the IADC, and the UN Long-Term Sustainability Working Group, all need to provide leadership here. Also the McGill Global Space Governance study and UNISPACE + 50 could play a constructive role.

Next Steps



- ✧ A systematic review of the entire field as briefly outlined (in this presentation) needs to be undertaken. This process that might be undertaken by the ICAO, FAA, EASA, IADC, UN OOSA, the Secure World Foundation and McGill University. These entities working in concert might assist in identifying in a systematic way where regulatory oversight, standards or new technology development is required or useful and to identify which national or international regulatory agency, governmental entity or private enterprise may be working in these areas. This could help to create a useful and globally accessible data base. This effort might also create a classification system for all of the more than a dozen “new aerospace markets” that are involved. This process needs to take into account not only the safety, health, and economic needs of developed countries but developing countries as well. If there is a UNISPACE + 50 this is a prime topic.