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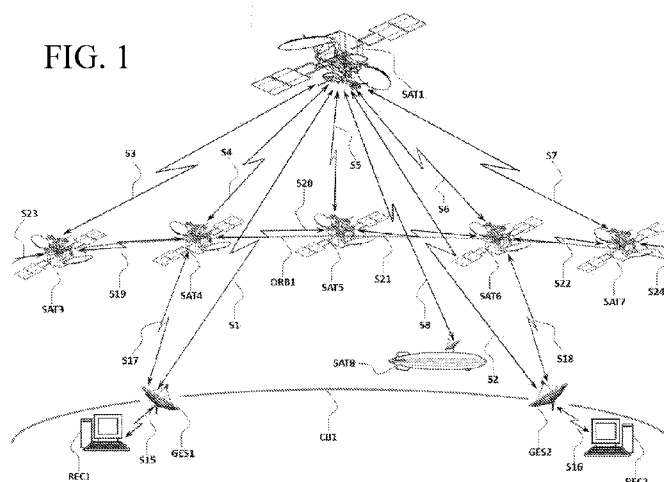
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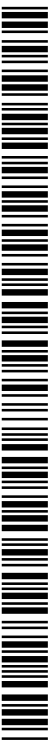
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(54) Title: SPACE-BASED ELECTRONIC DATA STORAGE AND TRANSFER NETWORK SYSTEM

FIG. 1



(57) Abstract: A space-based electronic data storage and transfer network system is disclosed. The network system includes terrestrial access points, a plurality of geostationary communications satellites, and a plurality of communicatively coupled low-earth orbit data storage satellites. The terrestrial access point establishes a link or communication with a geostationary communications satellite which relays the link or communication to a low-earth orbit data storage satellite for storing information contained within the link or communication. The terrestrial access point can also establish a link or communication with a geostationary communications satellite which relays the link or communication to a low-earth orbit data storage satellite requesting retrieval of information stored within the link or communication. Any low-earth orbit data storage satellite can access data from any other low-earth orbit data storage satellite through the communicative coupling. The network disclosed can be quickly and securely accessed from anywhere on earth.



**SPACE-BASED ELECTRONIC DATA STORAGE AND
TRANSFER NETWORK SYSTEM**

CROSS REFERENCE TO RELATED APPLICATIONS

5 [0001] This patent application claims the benefit of priority to U.S. Provisional Application No. 62/111,600, filed February 3, 2015, and titled “SkyCloud Autonomous Electronic Data Storage and Information Delivery Network System,” which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

10 [0002] The document relates generally to storage networks. This application relates more particularly to cloud storage networks remotely hosting data in orbital satellites and their use.

BACKGROUND INFORMATION

[0003] Over the years, computers have improved in size, speed, and performance, and the amount of data that a user creates, accesses and stores has grown exponentially. Traditional
15 backup solutions periodically copy data to local storage media such as a tape back-up, but, such solutions do not possess remote accessibility and may be vulnerable to device failure. With the creation of high speed internet access and mobile computing, the demand to remotely store and back up data has rapidly increased. Users (including organizations) are increasingly storing their data and even applications on remote data servers, and accessing their data and
20 applications remotely. Remote data storage providers must store data reliably over extended periods of time, and many users want access to their data quickly and from any location.

[0004] Cloud computing is a network system in which computing resources such as application programs and file storage are remotely hosted and accessed over the Internet or some other network. Today’s cloud storage networks use wired and wireless connections to transfer and
25 store electronic data to and retrieve electronic data from data centers located around the world. The majority of network access originates in urban areas where land and power are expensive, while most data centers are located in rural areas where land and power are cheap, introducing an additional delay as the data travels thousands of kilometers of wire through numerous junctions and access points. The owners of the wired and wireless networks can charge fees
30 for access, throttle users and services, and even create additional security risks. Additionally a user must be within the coverage area of a wired or wireless network to enable today’s cloud storage networks, making access in remote or unknown locations either difficult or impossible.

[0005] Terrestrial data centers require infrastructure including structures, a reliable power source, reliable high-speed communications accessibility, cooling, and physical security. Data center locations may expose users to unwanted jurisdictions or security risks, and governmental restrictions on geographical data storage location present a complicated set of rules for data access. Physical intrusion or local disaster at a data center could result in lost data, unauthorized access, or service interruption. A cloud storage network connected to the internet presents additional risks, as the network is inherently accessible through multiple servers and third party networks, subjecting electronic data stored therein to unauthorized access, hacking attempts, and electronic security breach.

[0006] Accordingly the inventors have recognized that there is a need for an improved remote data storage network free from the geographic and infrastructure requirements of modern data centers.

SUMMARY

[0007] Therefore there exists a continuing need for a new and improved remote data storage network that can be quickly, reliably, and securely accessed from anywhere in the world.

[0008] Various aspects of a uniquely designed space-based electronic data storage and transfer network system ("satellite cloud network") are disclosed. The satellite cloud network is configured to remotely store data in a series of storage satellites that can store and retrieve data and communicate that information to the planet's surface or to other satellites. A satellite may be any craft or body including balloons, blimps, aircraft, airborne drones, jets, gliders, ships, spacecraft, space stations, planetary stations, or traditional satellites in any orbit. In one aspect, the satellite cloud network includes a plurality of intercommunicating data storage satellites, each configured to store data, and each capable of sending data to or retrieving data from the other data storage satellite through a communications network (e.g., laser communication or radio frequency communication). A user can access the data on any of the data storage satellites through a communications link established with any one data storage satellite. In one aspect, the data storage satellites may occupy a low earth orbit (e.g., an orbit between 160 kilometers and 2000 kilometers above the earth's surface). In one aspect, access points (a terrestrial access point in the present example, but the invention would function with any access points on any celestial body, satellite, or craft) transmit data to and retrieve data from geosynchronous communications satellites (or any intermediate satellite at any orbit or position), and the communications satellites transmit data to or retrieve data from the storage satellites. This configuration enables a terrestrial access point to maintain a continuous

connection with the communications satellite while the communications satellite re-transmits data to the plurality of storage satellites. In other aspects, terrestrial access points could communicate directly with the plurality of intercommunicating data storage satellites.

[0009] In one aspect, each storage satellite would include a power system, one or more communications arrays, one or more data storage elements, and a control system.

[0010] The power system comprises one or more power sources (e.g., a solar panel, thermal harvesting, atomic fusion, atomic fission, chemical decay, or a free electron gathering system) electrically coupled to one or more batteries. A solar panel can collect solar energy to power the satellite and charge the batteries. The batteries provide back-up power when the satellite is shaded from the sun's rays by a planet or other body. In one aspect, the storage satellite includes robotics and electronic instructions capable of opening and closing the solar panel or directing the solar panel toward or away from the source of light to increase or decrease the energy absorbed. It may be beneficial to increase energy absorption prior to entering or just after leaving the earth's shade. It may additionally be beneficial to decrease energy absorption when the battery is near full or the satellite needs to reduce thermal energy.

[0011] The communications array can include a wireless communications system (e.g., laser communication link, microwave relay, or radio frequency transmission) capable of communicating with the other storage satellites. In one aspect each storage satellite's communications array is in constant communication with the communications arrays of the leading storage satellite immediately in front and the trailing storage satellite immediately behind. The storage satellites can create a continuous network, allowing any storage satellite to send data and instructions to or retrieve data and instructions from any other storage satellite in the network. In another aspect, each storage satellite is additionally capable of communicating with two or more satellites ahead and two or more satellites behind to improve network reliability and performance. A storage satellite can also communicate with storage satellites or relay satellites in alternate orbital planes or orbital radii. In one aspect, the communications array can additionally send and retrieve data and instructions with one or more communications satellites, and the one or more communications satellites send and retrieve data and instructions with the access points. In another embodiment, the communications array can send and retrieve data and instructions directly with the access points.

[0012] The data storage elements is powered by the power system and is coupled to the communications array through the processor. The data storage element can comprise magnetic hard drives, flash memory, 3D NAND memory, and/or holographic memory. In one aspect, a

single storage satellite's data storage element is capable of storing between 1 and 5 petabytes of data. The price and volume per byte, kilobyte, megabyte, gigabyte, terabyte, petabyte, and beyond decreases with time. In other embodiments, storage satellites with significantly increased storage beyond 5 petabytes could be preferable. In other embodiments, a satellite with less than 1 petabyte may be preferable (e.g., for a single enterprise server, or a satellite intended for limited duration storage). The data storage elements may be specially configured and mounted to dampen the pressure and vibration during launch, the temperature and pressure extremes in the vacuum of space, and/or radiation exposure outside of a planetary atmosphere. A magnetic hard drive may be pressurized and sealed to enable operation in a vacuum. In some aspects, the data storage element may suspend writing to the storage element or completely power down during periods of intense radiation to minimize damage. Any instruction or data received during disabled or suspended recording periods may be returned to the originating storage satellite or directed to another storage satellite. If the instruction or data is received from a communications satellite or relay satellite, the instruction or data will be directed to an alternate storage satellite for recording. The data storage element may also enter a low power or idle mode. The low power or idle mode may be beneficial to conserve power consumption, reduce heat, or disable some of the data storage elements during low traffic periods. The data storage elements may be shielded to minimize radiative interference. The data storage element may include the ability to flip or rewrite any corrupted bits. Data storage elements may be modular, replaceable, or expandable. The data storage elements may redundantly store data on multiple locations within and between storage satellites to securely back up data. In some cases an instruction received at the communications array from another storage satellite may bypass the processor and go directly to the data storage element to be recorded.

[0013] One or more processors are connected to persistent and/or non-persistent memory and control the operation of the power system, the communications array, and the data storage elements. Multiple storage satellites can pool processing power to jointly manage computation for complicated processes. The processors or the data storage elements may include encryption and/or deduplication instructions to protect data and to optimize storage. The processors may also include an authorization system to check access point credentials and make certain that the access point is authorized to send or retrieve data prior to providing access to the data storage element.

[0014] In one aspect, the storage satellite could include a position determining system, and a guidance or propulsion system so that the storage satellite can self-correct for orbital decay or adjust satellite spacing to optimize the addition or subtraction of other storage satellites into the network.

5 [0015] In one aspect, the storage satellite includes radiation and thermal shielding and other structural and support elements to improve the storage satellite's performance, reliability, and survival. One example of a beneficial support element would be a shock-absorbing system to minimize the vibration or thrust effects of launching the satellite into orbit. Another beneficial structural element could include mirrored surfaces to minimize unwanted thermal absorption.

10 In some embodiments, the storage satellite is configured and dimensioned with a heat management system to optimize heat absorption and dissipation in a vacuum. Solar exposure and electronic elements produce heat, even in a vacuum, and conduction and convection are nearly non-existent in the vacuum of space, so the satellite must optimize thermal energy through manipulating the dispersal and radiative dissipation of thermal energy, and this heat

15 management may include energy capture from heated elements, increased surface area (e.g. heat sinks) on some surfaces, and/or satellite rotation to avoid over-heating any side of the storage satellite due to prolonged solar exposure.

[0016] In some aspects, the storage satellites may also include proximity detection, collision detection, temperature detection, and/or radiation detection to increase the security and

20 survivability of the storage satellite. In one aspect, a storage satellite may include a self-destruct and/or self-erase element, which may include an explosive, an electromagnetic pulse, a memory ejector, and/or a memory wipe element. A self-destruct and/or self-erase element may be activated if unauthorized access is detected or if a storage satellite experiences a significant collision, a decaying orbit, or is scheduled to be decommissioned.

25 [0017] In one aspect, the storage satellites all occupy a single orbital plane. This plane could be aligned with a planet's equator or could have any inclination to the equator. In another aspect, the storage satellites are intentionally split into two or more orbital planes, increasing planetary coverage and decreasing the chance that a single object could disable the entire network through a series of collisions. Each orbital plane of storage satellite may form its own

30 continuous independent network loop or multiple orbital planes may be interwoven to form a larger network.

[0018] The distance above the earth determines the required velocity for the satellite to maintain a stable orbit, with the lowest orbits requiring the highest velocities so that the kinetic

energy balances the potential energy in a a stable orbit. The distance above the earth also determines the minimum number of satellites required to provide continuous communication between satellites, as the curvature of the earth will interfere with communication between distant satellites at low orbits. The higher the orbital radius for the storage satellites, the fewer satellites will be required. However, at certain heights, satellite orbit will travel through the Van Allen radiation belts, which can damage electronics and especially electronic data storage. The inner Van Allen radiation belt is a region of intense radiation extending in a roughly toroidal shape from approximately 4,500 to 7,600 miles (roughly 7,300 to 12,400) above the center of the earth (or 600 miles to 3,700 miles above the surface of the earth (roughly between 7,300 and 12,700 kilometers)). The outer Van Allen belt is a region of intense radiation extending from approximately 12,000 to 41,000 miles above the center of the earth with a peak intensity between 20,000 and 30,000 miles above the center of the earth. A geosynchronous (or a geostationary) orbit requires an approximate orbital radius of 26,199 miles from the center of the earth (or 22,236 miles above mean sea level), travelling through the highest intensity radiation region around the earth. The intense radiation can significantly and negatively impact electronics on geosynchronous orbit satellites, requiring significant shielding, which increases mass and launch cost.

[0019] In one aspect, the storage satellites orbit the earth in a low earth orbit. In a specific aspect, 6 storage satellites orbit the earth at a distance of 500 miles above the surface of the earth. This radius is inside of the inner Van Allen radiation belt, and is therefore shielded from most solar radiation. At this orbit, 6 storage satellites are capable of forming a continuous communication loop of storage satellites around the earth. In another aspect, 8 storage satellites orbit the earth at a distance of 500 miles above the surface of the earth, with 2 redundant storage satellites. These 8 storage satellites transmit data and instructions to and retrieve data and instructions from geosynchronous communications satellites, and the geosynchronous communications satellites in turn transmit data and instructions to and retrieve data and instructions from terrestrial access points. Other aspects comprise more or fewer storage satellites and occupy other orbital radii. In other embodiments, it may be preferable to choose any other orbital radius between the surface of the earth and the inner bound of the inner Van Allen radiation belt. In still another embodiment, it may be preferable to choose an orbital radius between the outer bounds of the inner Van Allen belt and the inner bounds of the outer Van Allen radiation belt. Data storage can be corrupted by radiation, and especially electron radiation, so either of the previous embodiments could take advantage of the relatively

low radiation regions either inside of the inner Van Allen belt or between the inner Van Allen belt and the outer Van Allen belt.

[0020] Another aspect incorporates a plurality of relay satellites providing additional connectivity and stability for the storage satellites. The relay satellites include communications
5 arrays and may function similar to a storage satellite, but with little or no data storage capability. As the relay satellites include fewer components, they are inherently smaller, lighter, and cheaper to launch into orbit. A network could function with as few as 1 storage satellite with other storage satellites in the previous examples replaced by relay (or “granddaughter”) satellites capable of completing the network chain.

10 [0021] Still another aspect includes a continuous network of storage satellites in geosynchronous orbit. As few as 3 geostationary storage satellites orbiting about the Earth’s equator could form a continuous communications network, though more satellites may provide superior stability and throughput.

[0022] Although specific aspects and embodiments are specifically described, it should be
15 readily understood that any of the above or below aspects or any of the elements described relating to any aspect, embodiment, claim, or description may be combined without departing from the present invention.

[0023] The benefits of the system disclosed herein are based on both the global accessibility and extreme isolation of orbiting satellites. Hosting an electronic data storage and transfer
20 network in a network of satellites removes a number of limitations that affect modern data centers, including global accessibility, unlimited geography, a free source of power, freedom from wired or wireless service provider restrictions, and the elimination of jurisdictional or unauthorized access concerns.

[0024] Wired networks require an uninterrupted physical cable between the user and an
25 internet or leased line/cable access point, and cables require established infrastructure. Current wireless networks require a line-of-sight connection or cover only a limited radius from a service tower or station. Line-of-sight is frequently impaired by geography, the curvature of the earth, buildings, and atmospheric interference. With even a limited number of satellites, a satellite cloud network can be accessed by any point on the surface of the earth, and each
30 additional satellite would improve coverage, storage capacity, and connection. A terrestrial access point can communicate with geosynchronous orbit satellites or with non-geosynchronous orbit (e.g., low-earth orbit, elliptical orbit, etc.) satellites.

[0025] Terrestrial data centers incur significant recurring costs, including leases, mortgages, property taxes, environmental remuneration expenses, and significant energy bills to both power and cool the data center. Space is not owned by any government or organization, so the only recurring expenses relate to maintenance and repair. Additionally, each satellite can be
5 freely and fully powered by solar energy absorbed by the satellite's solar panels or other independent power source. In some embodiments, the satellite includes robotics and programming to optimize solar energy absorption, including opening and closing the solar array and directing the absorption panels toward or away from the sun or another source of light. The satellite may include a battery for storing collected solar panel, enabling the satellite
10 to continue functioning during periods when the earth or another object blocks the sun's rays. In some embodiments, the satellite is capable of closing or angling the solar panels away from the sun when the battery is charged above a pre-determined threshold to minimize excess heat.

[0026] Satellites and spacecraft fall outside of traditional national borders and jurisdictions, and are subject to governmental jurisdiction and oversight only to the extent agreed upon by
15 international treaty. Currently, according to the Outer Space Treaty, each country retains jurisdiction over both its governmental and non-governmental spacecraft in space. Registered or launching a satellite from a country with more rigid privacy protections may maintain that country's jurisdiction over the satellite and allow a satellite provider to select the optimal country for data privacy. In this way, data stored in space may be protected from more
20 intrusive territorial jurisdictions and eliminate the risk of subpoena. Additionally, a satellite outside of the traditional national boundaries may be eligible to store data that could not be stored in some geographies on the earth. For example, the European Union has enacted legislation requiring strict protection, standards, and delectability for any service or cloud provider handling European citizens' personal data, and a significant effect of that law is that
25 European personal data cannot be stored in a number of jurisdictions with inadequate privacy protections. An orbital satellite cloud network operating under the laws of an appropriate country could securely comply with the personal data privacy requirement. Additionally the satellite cloud network could include geographic limitations that restrict access to restricted data only within approved terrestrial jurisdictions, to preserve personal data privacy. In
30 addition to electronic security from hackers and legal protection from government intrusion, the satellite is inherently secure from any type of physical intrusion once launched. No terrestrial data center security system can match the protection provided by travelling

thousands of meters per second through the vacuum of space more than 100 kilometers above the surface of the earth.

[0027] The satellite cloud network is completely isolated from any leased lines, and therefore is free from any fees, throttling, content blocking, or content promotion applied by service providers and network owners, originating from legacy government-granted monopoly or historical investment. A user with a terrestrial access point can point his communications array (e.g., antenna, satellite dish, or laser communication) toward the satellite without relaying any information through any outside networks. A terrestrial access point transmitting via a properly focused beam of communication can send information to the intended satellite, eliminating the risk of interception. Similarly a satellite transmitting via a properly focused beam of communication can send information to the intended terrestrial access point without any risk of interception.

[0028] In some embodiments, the satellite cloud network may operate completely independent and unconnected from the internet. Because the satellite cloud network is not interconnected with the internet, the satellite cloud network significantly reduces the risk of unauthorized access from hackers and unauthorized users. In combination with encryption, user authentication tokens, authorized access points, geographic restrictions, and other security protocols, the satellite cloud network provides a completely secure space-based cloud storage network to end-users requiring heightened protection of electronic data.

[0029] In one embodiment, the satellite cloud network comprises a number of storage satellites travelling in a low-earth orbit (between 160 kilometers and 2000 kilometers above the surface of the earth). Although orbital satellites are discussed in many embodiments, it should be obvious to one having ordinary skill in the art that a similar network relying on sub-orbital elements such as balloons, blimps, dirigibles, aircraft, watercraft, stationary data centers, or any combination thereof may be incorporated into a network without departing from the present invention. Each storage satellite is in communication with the satellite in front and the satellite behind it, creating a continuous loop or ring connecting each satellite in the ring. If one satellite stops working, all remaining storage satellites remain in network communication by sending data through the opposite direction. Additional or redundant satellites can also increase the flexibility and survivability of the network system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] FIG. 1 is a representation of a first embodiment of the satellite cloud network with all storage satellites occupying a single orbital plane.

[0031] FIG. 2 is a representation of a second embodiment of the satellite cloud network depicting the storage satellites split between 2 orbital planes.

DETAILED DESCRIPTION

[0032] Features, aspects and advantages are described below with reference to the drawings, which are intended to illustrate, but not to limit the invention. In the drawings, like reference characters denote corresponding features consistently throughout similar embodiments.

[0033] FIGS. 1 and 2 illustrate alternate embodiments of a space-based electronic data storage and transfer network system (“satellite cloud network” or “SkyCloud”).

[0034] FIG. 1 illustrates an embodiment of the satellite cloud network depicting a plurality of satellites occupying a single orbital plane (ORB1). An illustration of the positions of any number of satellites (SAT1, SAT3, SAT4, SAT5, SAT6, SAT7, SAT8) located on orbital plane ORB1 while communicating wirelessly together in orbit at any altitude above Earth, or any other celestial body (CB1), at any given time to provide space-based cloud storage and cloud networking connectivity while orbiting above and around and/or stationary above CB1.

[0035] The lightning bolts between various craft illustrate a bidirectional communication link between different elements of the fleet of wirelessly interconnected ground station transmission equipment (GES1 and GES2), airships and communications satellites (SAT1), and storage satellites (SAT3, SAT4, SAT5, SAT6, SAT7) containing electronic data storage memory elements or banks. Each element securely transmits electronic data for storage, retrieval, and distribution anywhere on CB1 or to any other element of the fleet through the network of wirelessly interconnected satellite and/or terrestrial access points or ground station transmission equipment (GES1 and/or GES2). Unlike traditional passive or active communications satellites that simply reflect or amplify and immediately rebroadcast a received signal, the storage satellites (SAT3, SAT4, SAT5, SAT6, SAT7) record a file containing data extracted from the signal to an electronic data storage element within the storage satellite. That file can be requested and retrieved at any time from any authorized location within the satellite cloud network (until the file is intentionally deleted or replaced). Once a storage satellite records a file from a signal, the storage satellite may perform additional tasks such as de-duplication, compression, and/or encryption to create a processed file. The storage satellite will then transmit the processed file to at least one other satellite in the network to provide a redundant data back-up. In other embodiments, the storage satellite will not process the file, and will transmit the file as received as a redundant backup. A later request to access the file may be simultaneously fulfilled by each satellite containing a copy of the file.

The file may be broken up into smaller file pieces for storage and speedy transmission and re-assembled at the requesting terminal.

[0036] The satellite cloud network can authenticate the users associated with GES1 and GES 2 prior to allowing the sending and/or retrieving of electronic data through focused, encrypted
5 wireless communications. The data can be transmitted via wireless and/or wired connections to and from the at least one computer, mobile device, or electronic data recording device (REC1 and REC2).

[0037] Encrypted electronic data is transmitted to/from GES1 and/or GES2 using at least one wireless signal of S1, S2, S17 and S18 to any available satellite SAT1, SAT3, SAT4, SAT5,
10 SAT6, SAT7 or SAT8 to be distributed for storage and retrieval to any number of satellite(s), airship(s) or end-user wirelessly interconnected to the space-based cloud storage and cloud networking system via at least one wireless signal of S1, S2, S3, S4, S5, S6, S7, S8, S17, S18, S19, S20, S21 and S22.

[0038] Cross-satellite wireless signals S23 and S24 extending outside SAT3 and SAT7
15 indicates the connection to other satellites (not shown) to form a continuous satellite cloud network for providing service to end-users located anywhere on, above or around the celestial body (CB1).

[0039] Network architecture, devices, protocols, procedures, systems, encryption, multifactor authentication, anti-jamming and interference mitigation techniques, and wireless inter-satellite
20 and ground links are utilized to distribute electronic data to any other point in the satellite cloud network and/or to any authorized end-user with ground station transmission equipment on CB1.

[0040] FIG. 2 illustrates an embodiment of a space-based electronic data storage and transfer network system illustrating a plurality of storage satellites orbiting within a first orbital plane (ORB1) and a plurality of storage satellites orbiting within a second orbital plane (ORB2). The
25 satellites in each of the orbital planes may be configured to communicate wirelessly together forming meshed connectivity from multiple orbits (ORB1 and ORB2) at any altitude above celestial body CB1 at any given time. This architecture depicts a primary fleet of electronic data storage and communications satellites on ORB1 communicating with a redundant (back-
30 up) fleet of electronic data storage and communications satellites on ORB2 through wireless signals S26, S27, S28, S29, S30, S31 and S32 each securely transmitting electronic data to/from end-users located in various geographical regions and to/from other satellites and airship(s).

[0041] In an alternate embodiment (not shown), each orbital plane may operate entirely independently from each other, completing multiple independent, self-contained satellite cloud networks. Certain enterprises such as a branch of the military may desire a private, dedicated, completely secure satellite cloud network, immune to unauthorized access.

5 [0042] The encrypted electronic data stored on the space-based cloud storage network may be retrieved by any end-user, from various geographical and aerial locations and authorized through multiple security keys. As part of the cloud storage and networking functions of the system, end-users can also send electronic data of any kind to one another using any applicable part of the wirelessly interconnected system.

10 [0043] All satellite spacecraft/airships are in orbit above ground (i.e. Earth and/or any other celestial body) and the transmission of electronic data cross-linked (meshed) among the satellites and, in turn, to/from the end-users takes place using optical laser communication links and/or radio frequency communication links as part of an autonomous secure bidirectional meshed cloud storage network.

15 [0044] The proposed system allows for electronic data belonging to SkyCloud end-users to be securely transmitted to/from the SkyCloud data storage network system for the purposes of saving, sending, receiving, storing, refreshing, and/or retrieving their own electronic data as part of a space-based cloud storage and cloud networking service.

[0045] The SkyCloud network will have the ability to remain autonomous from the Internet or
20 any other public networks for each end-user. SkyCloud end-user electronic data is transmitted, stored and replicated (backed-up) redundantly using SkyCloud's storage protocols, configurations, procedures, architecture and highly secure hardware-encoded encryption in the SkyCloud end-user communications transmission equipment and on Mother satellites and Daughter satellites in orbit above ground.

25 [0046] The stored electronic data is available only to end-users in possession of secure multifactor authentication keys and biometric protocols required for entry to their part(s) of the SkyCloud network. It is also deliberately stored in such a way as to redundantly protect SkyCloud end-user data through site diversity and multiple encrypted wireless pathways/signals. Each SkyCloud end-user is uniquely identified to securely and redundantly
30 preserve ownership and control of the end-user's electronic data on the SkyCloud network system. In matters concerning jurisdictional isolation requirements faced by any SkyCloud end-user, electronic data storage belonging to any SkyCloud end-user will be isolated to only

the territories and/or jurisdictions allowed by the end-user without exposure to any unintended network(s).

[0047] The stored electronic data is securely transmitted to/from SkyCloud end-users using communications transmission equipment terminals to wirelessly communicate via radio
5 frequency and/or optical laser transmissions with the Mother satellite(s) having service coverage over the relevant SkyCloud end-user geographic region. Mother satellite(s) would be available in orbit above ground to provide service to SkyCloud end-users in various regions. Daughter satellite(s) in orbit above ground would be used for collection, retrieval, storage and back-up of SkyCloud end-user electronic data, in addition to the ability to provide service to
10 SkyCloud end-users in various regions. The SkyCloud network system is designed to be capable of growing to modularly accommodate additional end-users and any number of additional Mother satellites and Daughter satellites in orbit above ground.

[0048] In addition, the SkyCloud system is designed to employ technologies to provide protective system attributes such as encryption, fast frequency hopping, narrow beam pointing
15 and isolation and optical laser transmission modulation to augment secure anti-jamming and interference mitigation capabilities to restrict access to any unauthorized party(ies) and/or to any demarcated geographic regions (e.g. a city or a country).

[0049] SkyCloud's proprietary storage protocols, procedures, satellite architecture, network management and communications systems are utilized to securely store, buffer and/or forward
20 the electronic data to/from the Mother satellite, correct it for any errors and then transmit it to/from a Daughter satellite for storage, redundant back-up and retrieval to any number of Mother Satellites, Daughter satellites and/or airships. For added redundant secure back-up purposes, the electronic data is further transmitted among the Daughter satellites in orbit above ground via optical laser and/or radio frequency wireless communication links established
25 between the Mother satellites and Daughter satellites.

[0050] In order to preserve memory chip array lifespan, to conserve power consumption and to avoid unnecessary radiation exposures, addressed memory arrays on the satellites will be actively managed to fluctuate from an idle state to an active state when an end-user begins
30 accessing SkyCloud system to send or retrieve electronic data using the network and/or to store the electronic data on the network for the purposes of archiving and/or future retrieval.

[0051] Electronic data may be privately and securely accessed by end-users from any region on Earth, or any celestial body, where Mother satellite and/or Daughter satellite coverage exists, and the electronic data would then be available for transmission to/from any number of

Mother satellites and Daughter satellites in orbit above ground. SkyCloud end-users can communicate directly and privately with the Mother satellites and/or the Daughter satellites for storage, transmission, back-up and retrieval purposes, and they also have the ability to use the SkyCloud system as a bidirectional autonomous network for secure electronic data, email,
5 information and message delivery to other SkyCloud end-users.

[0052] The Mother satellite(s) and Daughter satellite(s) orbit above ground and securely transmit the electronic data to/from other Mother satellites and Daughter satellites using optical laser and/or radio frequency wireless communications links, and using corresponding targeting/tracking equipment to optimize secure transmissions.

10 [0053] The process for collecting the electronic data from the SkyCloud end-user and forwarding it to/from the Mother satellites and Daughter satellites is set-up to be completely secure, private, autonomously managed and independent of any Internet or public electronic data networks.

[0054] As more electronic data storage capacity is desired or needed, additional Mother
15 satellites and Daughter satellites can be built and placed in orbit for seamless integration into the SkyCloud network system.

[0055] Navigation and fleet management of Mother satellites and Daughter satellites are performed by Telemetry, Tracking and Control (“TT&C”) stations placed where geographically desired. The TT&C functions do not control the electronic data storage
20 network management functions. Rather, these are wirelessly controlled by a SkyCloud network control center. Daughter satellite TT&C monitoring and requests can be transmitted directly from the ground to any Daughter satellite which can in turn relay the TT&C transmissions to any other Daughter satellite wirelessly connected to the SkyCloud network. The SkyCloud network can also accept Daughter satellite TT&C transmissions indirectly via
25 wireless links from the ground to any Mother satellite wirelessly relayed to the Daughter satellite(s) accordingly.

[0056] At the SkyCloud network control center’s discretion, the management of private electronic data storage network protocols, procedures, software and secure encryption on the entire SkyCloud satellite network can be autonomously conducted among the Mother satellites
30 and Daughter satellites without the need for assistance from any ground-based communications station.

[0057] SkyCloud end-users are enabled to generate secure multifactor management keys and rights to securely send/receive their own private stored electronic data to/from any Mother

satellite and/or Daughter satellite to/from any other authorized SkyCloud end-user in the SkyCloud network system (e.g. For example, electronic data sent to/from a ground-based electronic data storage center, or to/from a different end-user location within the same end-user enterprise, etc.). For added data security, SkyCloud end-users will have the ability to have
5 their data expunged as it is being transmitted and stored to the SkyCloud network system.

[0058] Anti-jamming, interference mitigation, narrow beam pointing/isolation, optical laser transmission modulation, fast frequency hopping and hardware encryption keys are features built into the unique architecture of the Mother satellite(s) communicating with Daughter satellite(s) to provide reliable, secure and autonomous transmissions.

10 [0059] SkyCloud protocols for primary and redundant (backed-up) data storage will be configured to replicate all data on different Mother satellite(s) and/or Daughter satellite(s) from the relevant satellite where the data has been originally stored. This enhances site diversity to avoid loss of critical data in the event of a Daughter satellite loss or failure.

[0060] SkyCloud Daughter satellites can be configured to remain wirelessly interconnected
15 while remaining on two different orbital planes to reduce/limit risks of space debris damage to a Daughter satellite perpetuating to damage other Daughter satellites on the same orbital plane. By placing primary stored data on Daughter satellites in one orbital plane and redundant (backed-up) stored data on Daughter satellites in another/separate orbital plane, the risk of accidental impact with orbital debris perpetually resulting in the destruction of all stored
20 electronic data on the SkyCloud network is significantly minimized.

[0061] The Space-based Electronic Data Storage and Transfer Network System (hereinafter “SkyCloud”) would employ a dedicated constellation of satellite spacecraft (i.e. balloons, blimps, aircraft, airborne drones, jets, gliders, spacecraft, and space and planetary based stations, colonies and independent modules) placed anywhere in orbit above ground in the sky
25 and/or in space to enable cloud storage and networking service provision of electronic data storage, and delivery of electronic data information to SkyCloud end-users in any desired geographical region(s). SkyCloud is an entirely space-based and/or sky-based high throughput data storage, transfer and retrieval network that can remain autonomous and independent of any connection or interaction with any other networks.

30 [0062] SkyCloud master communications satellite spacecraft/airships in orbit above ground (hereinafter “Mother satellite(s)”) will possess telecommunications equipment and electronic data storage memory bank capacities to provide managed bidirectional electronic data storage

network services via secure communications to SkyCloud end-users located in any desired geographical territories.

[0063] SkyCloud satellite spacecraft/airships primarily dedicated to storage, retrieval and transfer of electronic data in any available orbit or altitude above ground (e.g. flying at any altitude, geostationary, elliptical, sun-synchronous, polar, intermediate, and/or low Earth orbit(s)) (hereinafter “Daughter satellite(s)”) will communicate via optical laser and/or radio frequency transmission links with any accessible Mother satellite to serve as data memory storage facilities for recording, collection and retrieval of electronic data transmitted by SkyCloud end-users via any Mother satellite.

[0064] Each Mother satellite will communicate with end-users via optical laser communication links and/or via any approved radio frequencies (i.e. X-band, Ku-Band, Ka-band, V-band, W-band, Q-band, C-Band, L-Band, S-Band, or any other ITU-recognized frequency) approved for use by the authorized United Nations governing body, the International Telecommunications Union (ITU).

[0065] SkyCloud end-users would privately communicate with the SkyCloud satellite spacecraft/airships to store and/or redundantly back-up electronic data through wireless bidirectional radio frequency and/or optical laser communications transmissions using a variety of telecommunications equipment terminals pointed at any accessible SkyCloud satellite and/or airship.

[0066] The electronic data stored in each Daughter satellite will be available for transfer, collection and/or retrieval by one or more Daughter satellite(s) and/or Mother satellite(s) interconnected together via wireless optical laser and/or radio frequency communications links.

[0067] Private and secure communications by SkyCloud end-users with any Mother satellite will be fully encrypted both by proprietary SkyCloud electronic data storage algorithms and protocols and by the SkyCloud end-users. The electronic data would be transmitted to/from the SkyCloud end-user located on any celestial body, then subsequently to/from the Mother satellite, and then subsequently to/from the Daughter Satellite. All wireless communications in the SkyCloud network will take place with secure system data access permission(s)/authorization(s).

[0068] SkyCloud will independently bypass and remain autonomous of any and all unauthorized communications systems and networks. SkyCloud will therefore provide a completely self-contained space-based and/or sky-based electronic data cloud storage network system.

[0069] Any part of the SkyCloud end-user's electronic data stored on this network system may be shared with any other authorized SkyCloud end-user(s) as an electronic data storage and distribution method if so desired by the SkyCloud end-user. SkyCloud end-users will have the ability to communicate with the SkyCloud network system directly to avoid use of alternative
5 networks such as ground-based internet facilities and/or communications cables. SkyCloud end-users will communicate directly and privately with the SkyCloud satellite spacecraft and/or airships, and they will also have the ability to use the SkyCloud system as a private bidirectional network for secure data transfer to facilitate usage of software applications such as SQL, Oracle Database and SAP, and video, fund transfer, email, and message delivery
10 applications to other SkyCloud end-users.

[0070] Additional Daughter satellites can be placed in orbit and accommodated by the existing network of Mother satellites, Daughter satellites and end-users to modularly expand the SkyCloud electronic data storage memory capacities available in the cloud storage network. Each additional Daughter satellite will be loaded with new electronic storage memory bank
15 capacities and other equipment (e.g. routers, processors, controllers, software, etc.) as required for communications with the Mother satellites and other Daughter satellites communicating with the end-users in the network.

[0071] Each Daughter satellite will be equipped with satellite telemetry, tracking and control (TT&C) transmission equipment for navigational positioning, and optical laser and/or radio
20 frequency communication equipment for transmission links using direct communications links to a celestial body, or indirectly by wirelessly communicating to/from any Mother satellite(s) and/or with any other Daughter satellite(s) to send/receive any TT&C command, information and/or instruction.

[0072] Each Mother satellite will have the ability to simultaneously track and radio frequency
25 transmit and/or optically laser link with other Mother satellites and multiple Daughter satellites, and each Daughter satellite will have the ability to simultaneously track and radio frequency transmit and/or optically laser link with Mother satellites and other Daughter satellites to create an autonomously reliable and redundant self-contained electronic data cloud communications and storage network system.

[0073] The Daughter satellites can be interconnected with one another via wireless
30 communications links (i.e. using radio frequencies and/or optical lasers) to form a continuous uninterrupted bidirectional communications network circuit/ring around the world. This will facilitate links to any Daughter satellite(s) by having electronic data transmissions traverse the

ring in an opposite direction in case of a satellite failure that could interrupt SkyCloud in a particular direction. In case of any Daughter satellite being unavailable for any reason, the remaining Daughter satellites can be accessed via satellite communications crosslinks established and available in any number of alternately available directions/paths.

5 [0074] Electronic data storage equipment placed on the Mother satellite(s) and Daughter satellite(s) to facilitate and provide a space-based cloud storage and cloud networking system will consist of any number and combination of hard-drive(s), silicon-based flash memory device, 3D NAND flash memory device, holographic memory device, signal processors, digital processors, routers, controllers, software, and state-of-the-art technologies and electronics
10 required for providing a secure, robust and high-throughput cloud storage and cloud networking system (hereinafter the “Memory Systems”).

[0075] Software and electronics used in related controllers and routers in the SkyCloud network will multiply and increase the storage capacities of electronic data Memory Systems through the independent processes of deduplication and compression.

15 [0076] Isolating and protecting primary electronic data storage from redundant (back-up) electronic data storage on different Daughter satellites and/or airships will be important to avoidance of accidental damage from space debris or other objects. This will be accomplished by putting the Daughter satellites on separated and different orbital planes above ground with wirelessly (i.e. using radio frequency and/or optical laser) interconnected satellite crosslinks to
20 preserve a single unified meshed communications network above any celestial body.

[0077] In matters concerning jurisdictional isolation requirements, electronic data storage belonging to any SkyCloud end-user will be isolated to only the territories and/or jurisdictions allowed by the end-user without exposure to any unintended network. The SkyCloud network will have the capability, as directed by the end-user, to disqualify any jurisdictionally
25 disallowed territories from intentional and/or unintentional peering and/or receiving of any electronic data stored on the network(s).

[0078] The satellite network can also include simple relay satellites that only contain the technical ability to buffer, route and communicate electronic data using radio frequencies and/or laser communications to Mother satellite(s), other Daughter satellite(s), and/or end-users
30 on or above ground, in order to enhance the number of wireless inter-satellite connections available on the network to achieve higher data redundancy, speed of routing, throughputs and meshing of the network (hereinafter “Granddaughter satellite(s)").

[0079] While the above implementations and aspects primarily discuss incorporating data storage elements into low-earth orbiting storage satellites and allowing access points to communicate with the low-earth orbiting storage satellites through geostationary communications satellites, it is to be understood that a network incorporating a different configuration of satellites and storage elements could be configured to work without departing from the spirit of the present invention. One alternate embodiment would incorporate data storage elements directly into geostationary satellites, enabling a terrestrial user to directly access the data storage satellites. Such a configuration would require additional shielding surrounding the data storage element, due to the intense Van Allen radiation belt at earth's geosynchronous orbital radius; however, the same concern would not be true for all celestial bodies. For example, a lunar-synchronous orbital satellite orbiting the moon would not pass through such severe radiation belts and would not require additional shielding (beyond the shielding required for reliable performance outside of the radiation shielding effect that the Van Allen belts provide for objects close to the Earth). Such a satellite cloud network could be configured to work in many configurations and with additional satellites without departing from the spirit of the present invention. Such a satellite cloud network would provide similar benefit whether the access point communicates directly with the storage satellites or communicates through intermediate communications satellites. Similarly, it should be understood that the configurations and teachings regarding a network of data storing satellites orbiting the Earth, the teachings can be readily applied to other bodies, such as for example, balloons, blimps, aircraft, airborne drones, jets, gliders, ships, spacecraft, space stations, planetary stations, in addition to conventional orbital satellites. For example, an orbital communications satellite could communicate with a floating or submerged data center in the ocean. In some embodiments, the satellite cloud network could be configured to include more or fewer satellites, a greater or lesser orbital radius, more or fewer orbital planes, different types of satellites, multiple independent networks, alternative communication systems, sensors or security means.

[0080] Although various aspects and implementations are herein disclosed in the context of certain preferred embodiments, implementations, and examples, it will be understood by those skilled in the art that the present invention extends beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the inventive aspects and obvious modifications and equivalents thereof. In addition, while a number of variations of the aspects have been noted, other modifications, which are within their scope, will be readily

apparent to those of skill in the art based upon this disclosure. It should be also understood that the scope this disclosure includes the various combinations or sub-combinations of the specific features and aspects of the embodiments disclosed herein, such that the various features, modes of implementation and operation, and aspects of the disclosed subject matter may be combined
5 with or substituted for one another. Thus, it is intended that the scope of the present invention herein disclosed should not be limited by the particular disclosed embodiments or implementations described above, but should be determined only by a fair reading of the claims.

[0081] Similarly, this method of disclosure is not to be interpreted as reflecting an intention
10 that any claim require more features than are expressly recited in that claim. Rather, as the following claims reflect, inventive aspects lie in a combination of fewer than all features of any single foregoing disclosed embodiment. Thus, the claims following the Detailed Description are hereby expressly incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment.

15

WHAT IS CLAIMED IS

1. A space-based electronic data storage and transfer network system comprising:

an access terminal located on the Earth, the access terminal including at least one terminal communications array configured to transmit a file;

5 a first storage satellite including a power system and at least one first satellite communications array configured to receive the file from the access terminal, the at least one first satellite communications array being communicatively coupled through a first processor to at least one first data storage element, the at least one first data storage element being configured to record the file to the first data storage element, the at least one first
10 satellite communications array configured to transmit the file.

2. The space-based electronic data storage and transfer network system according to any of the preceding claims further comprising a second storage satellite including a power system and at least one second satellite communications array configured to receive the file from the first storage satellite, the at least one second satellite communications array being
15 communicatively coupled through a second processor to at least one second data storage element, the at least one second data storage element being configured to record the file to the second data storage element.

3. The space-based electronic data storage and transfer network system according to any of the preceding claims further comprising a complete communicative network of storage
20 satellites.

4. The space-based electronic data storage and transfer network system according to any of the preceding claims further comprising additional access terminals, each capable of transmitting files to the storage satellites.

5. A space-based electronic data storage and transfer network system comprising:

25 a plurality of storage satellites each including at least one data storage element;

a communication satellite configured to receive a file from an external source and to transmit the file to a storage satellite for storage; and

wherein the storage satellite records the file to a data storage element.

6. The space-based electronic data storage and transfer network system according to any of
30 the preceding claims, wherein the storage satellites are configured to retransmit the file to be redundantly recorded on at least a second storage satellites.

7. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein each of the plurality of storage satellites is configured to communicate with the two closest storage satellites.
8. The space-based electronic data storage and transfer network system according to any of
5 the preceding claims, wherein a second storage satellite is configured to relay transmit the file received from a first storage satellite to a third storage satellite.
9. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of storage satellites are configured and positioned so that a file can be transmitted from any storage satellite to any other satellite
10 through a series of relay transmissions.
10. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the communication satellite is configured to request a file from a first storage satellite and the first storage satellite is configured to retrieve the file from any other storage satellite through a series of relay transmissions.
- 15 11. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the communication satellite is configured to transmit the file to a first storage satellite and the first storage satellite is configured to transmit the file to any other storage satellite through a series of relay transmissions.
12. The space-based electronic data storage and transfer network system according to any of
20 the preceding claims, wherein the communication satellite is configured to break the file into a plurality of file fragments and each of the file fragments is redundantly recorded to at least two storage satellites.
13. The space- based electronic data storage and transfer network system according to any of the preceding claims, wherein each storage satellite is configured to directly communicate
25 only with other storage satellites and with the communication satellite.
14. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein only the storage satellite closest to the communication satellite communicates with the communication satellite.
15. The space-based electronic data storage and transfer network system according to any of
30 the preceding claims wherein the communication satellite is configured to occupy a geosynchronous orbit and the plurality of storage satellites are configured to occupy low earth orbits.

16. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of storage satellites are split into at least two orbital planes.
17. The space-based electronic data storage and transfer network system according to any of
5 the preceding claims, wherein each file is redundantly stored in at least one storage satellite of each orbital plane.
18. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of storage satellites are configured to occupy a low earth orbit of approximately 700-900 kilometers above the earth's surface.
- 10 19. The space-based electronic data storage and transfer network system according to any of the preceding claims comprising 6 or more storage satellites.
20. A satellite data network comprising a plurality of storage satellites, each storage satellite comprising:
- 15 a power system comprising a power source and an energy storage component capable of storing energy received from the power source;
 - a data storage element powered by the power system;
 - a communications array powered by the power system and configured for communicating with other storage satellites in the satellite data network, the communications array additionally configured to communicate with an authorized outside satellite that is not a
20 storage satellite;
 - a processor powered by the power system and coupled to the communications array and the data storage element, the processor configured to process the recordation of files to and retrieval of files from the data storage element, the processor additionally configured to process the signals received from or sent to the communication array; and
- 25 wherein the storage satellites are communicatively coupled to each other through a continuous loop of relays between consecutive storage satellites.
21. The satellite data network according to any of the preceding claims wherein the processors of the plurality of storage satellites work together to distribute data between the storage satellites.
- 30 22. The satellite data network according to any of the preceding claims wherein a storage satellite receiving a file request from the authorized outside satellite can retrieve files or portions of files responsive to the file request from any other storage satellite through the continuous loop of relays.

23. The satellite data network according to any of the preceding claims wherein a storage satellite receiving a file request from the authorized outside satellite can retrieve files or portions of files responsive to the file request simultaneously from each direction of the continuous loop of relays.
- 5 24. The satellite data network according to any of the preceding claims wherein the files are deduplicated prior to being recorded to the data storage element.
25. The satellite data network according to any of the preceding claims wherein the files are reduplicated after they are retrieved from the data storage element and before they are transmitted to an authorized outside satellite.
- 10 26. The satellite data network according to any of the preceding claims wherein the data storage element comprises holographic memory.
27. The satellite data network according to any of the preceding claims wherein the data storage element comprises 3D NAND memory.
28. The satellite data network according to any of the preceding claims wherein the data
15 storage element is surrounded by a radiation shield.
29. The satellite data network according to any of the preceding claims wherein each bit of the data storage element can be independently reset to correct after radiative interference.
30. The satellite data network according to any of the preceding claims wherein the plurality of
20 storage satellites are configured to occupy a low earth orbit approximately 700-900 kilometers above the earth's surface.
31. The satellite data network according to any of the preceding claims comprising at least six storage satellites.
32. The satellite data network according to any of the preceding claims comprising at least four storage satellites in each of two orbital planes.
- 25 33. The satellite data network according to any of the preceding claims wherein the communications array comprises a laser communication link.
34. A space-based electronic data storage and transfer network system comprising:
at least one communication satellite comprising:
a first power system comprising a first power source and a first energy storage
30 component capable of storing energy received from the first power source;
a first communications array powered by the first power system and configured for communicating with a ground-based communication station;
a second communications array powered by the first power system; and

a processor powered by the first power system and coupled to the first and second communications arrays; and

a plurality of storage satellites, each storage satellite comprising:

a second power system comprising a second power source and a second energy storage component capable of storing energy received from the second power source;

a third communications array powered by the second power system and coupled to both the second communications array of the communication satellite and the third communications array of other storage satellites;

at least one data storage element powered by the second power system; and

a processor powered by the second power system and coupled to the third communications array and the at least one data storage element, the processor configured to record data from uploads received by the third communication array to the at least one data storage element and retrieve data from the at least one data storage element in response to data requests received by the third communication array.

35. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of storage satellites are configured to occupy and operate within a low earth orbit.
36. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of communication satellites are configured to occupy and operate within a geosynchronous orbit.
37. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein the plurality of storage satellites are configured to occupy a low earth orbit approximately 700-900 kilometers above the earth's surface.
38. The space-based electronic data storage and transfer network system according to any of the preceding claims comprising at least six storage satellites.
39. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the storage satellites are communicatively coupled to each other through a continuous loop of relays between consecutive storage satellites
40. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein a storage satellite receiving a file request from the communication satellite can retrieve files or portions of files responsive to the file request from any other storage satellite through the continuous loop of relays.

41. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein a storage satellite receiving a file request from the communication satellite can retrieve files or portions of files responsive to the file request simultaneously from each direction of the continuous loop of relays.
- 5 42. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the files are deduplicated prior to being recorded to the data storage element.
43. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the files are reduplicated after they are retrieved from the data storage element and before they are transmitted to the communication satellite through the third communications array.
- 10 44. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the second data storage element comprises holographic memory.
- 15 45. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the data storage element comprises 3D NAND memory.
46. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the data storage element is surrounded by a radiation shield.
47. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein each bit of the data storage element can be independently reset to correct after radiative interference.
- 20 48. The space-based electronic data storage and transfer network system according to any of the preceding claims wherein the communications arrays comprise laser communication links.
- 25 49. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising simultaneous provisioning and establishing bi-directional and secure wireless delivery and receipt of electronic data of any kind to/from end-users employing communications equipment for transmission, collection, storage, back-up, retrieval, transfer and access of electronic data to/from end-users and satellite(s) in network.
- 30 50. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising electronic data error correction and network

routing for assuring reliable high throughput electronic data transmission, distribution and storage to/from the space-based electronic data storage and transfer network.

5 **51.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising encryption protocols and techniques and conditional end-user access and multifactor authentication keys for authorization to enter and securely manage electronic data stored and transmitted to/from network.

10 **52.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising the deployment of any number of interconnected satellites required at any designated altitude in space or in the sky to create an uninterrupted and continuously interconnected wireless network circuit for cloud storage, computing and networking around the Earth, or any other celestial body.

15 **53.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising autonomous space-based storage network management performed independently, directly, intelligently and securely by at least one or more satellite(s) connected to network.

20 **54.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising ground-based network management (i.e. network management involving software uploads, updating, repairs, analysis, optimization, access and monitoring of all wirelessly interconnected satellite(s) in network) (hereinafter the “Network Management”) through any single wirelessly interconnected satellite to cause all of the satellite(s) to become sequentially and continuously available to wirelessly interconnect with the ground-based communications station equipment for the purposes of Network Management and for Telemetry, Tracking and Control (TT&C) of satellite(s) in network.

25 **55.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising autonomous network management among satellite(s) in network.

30 **56.** The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising end-user controlled and managed bidirectional network transmissions, redundant back-up, retrieval and transfer of electronic data to/from any other desired end-user location(s) using the wirelessly interconnected satellite(s) to relay, retrieve, update, store or exchange electronic data as needed with other end-user(s) of or satellite(s) in network.

57. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising electronic data storage memory banks in the satellite(s) for the buffering of electronic data transmission streams for transfer or relay to other satellite(s) for the purpose of storage, redundant back-up, transport, delivery and/or retrieval to/from network.
58. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising any number of satellite(s), either stationary or moving, located at any available altitudes and on any orbital paths/planes in space and/or in the sky above the Earth, or any other celestial body, to wirelessly interconnect together to form a unified interconnected cloud storage communications network, as implemented and interconnected via radio frequency and/or optical communications transmission devices and systems, to communicate with end-users located on or above Earth, or any other celestial body, for the provision of high throughput wireless communication of electronic data to enable cloud storage, cloud computing and cloud networking services using network.
59. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising protocols, technologies, devices, practices, instructions and features for dynamically, continuously and securely enabling, provisioning, preserving, protecting and verifying the performance and functionality of all systems, devices, procedures and protocols comprising network.
60. The space-based electronic data storage and transfer network system according to any of the preceding claims, wherein further comprising fast radio frequency hopping technologies providing wireless anti-jamming and interference mitigation security features to network.
61. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising narrow radio frequency transmission beam isolation technologies providing wireless anti-jamming and interference mitigation security features in network.
62. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising hardware and software based security encryption technologies providing wireless anti-jamming and interference mitigation security features in network.

63. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising optical laser transmission modulation technologies providing anti-jamming and interference mitigation security features in network.
- 5 64. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising hardware and software based security encryption designed and integrated into the end-user communications transmission equipment to establish wireless transmission security layers using any combination of end-user alpha-numeric and biometric identification along with multifactor end-user generated encryption keys to prevent unauthorized access to electronic data stored and transmitted to/from
10 network, thereby facilitating secure wireless communications with and among any satellite(s) in network.
65. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising enabling end-users to automatically or optionally expunge electronic data as it is being transmitted error-free to/from any satellite(s) in
15 network.
66. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising establishing lower catastrophic and/or perpetual loss risk from accidental damage by space debris or object(s) to network by separating primary from redundantly stored electronic data and transmitting and/or transferring it for
20 storage to different satellite(s) on the same orbital plane/path to establish electronic data storage site diversity in network and/or to different satellite(s) on separate orbital plane(s)/path(s) for mitigation of space debris or object(s) colliding with or damaging any single satellite in network thereby generating additional space debris and causing added catastrophic damage from the perpetual propagation of faster moving debris to adjacent
25 satellite(s) on the same plane/path.
67. The space-based electronic data storage and transfer network system according to any of the preceding claims, further comprising electronic data storage memory bank power distribution command and management controls to automatically activate said storage memory bank to a higher power mode/state at the time an end-user associated with specific
30 electronic data stored in network begins to login to access network, and to keep the electronic data storage memory banks safe and undamaged from exposure to space-borne radiation, and to protect the electronic data storage memory bank's usable lifespan by keeping it in an idle lower-power mode/state during said radiation exposure.

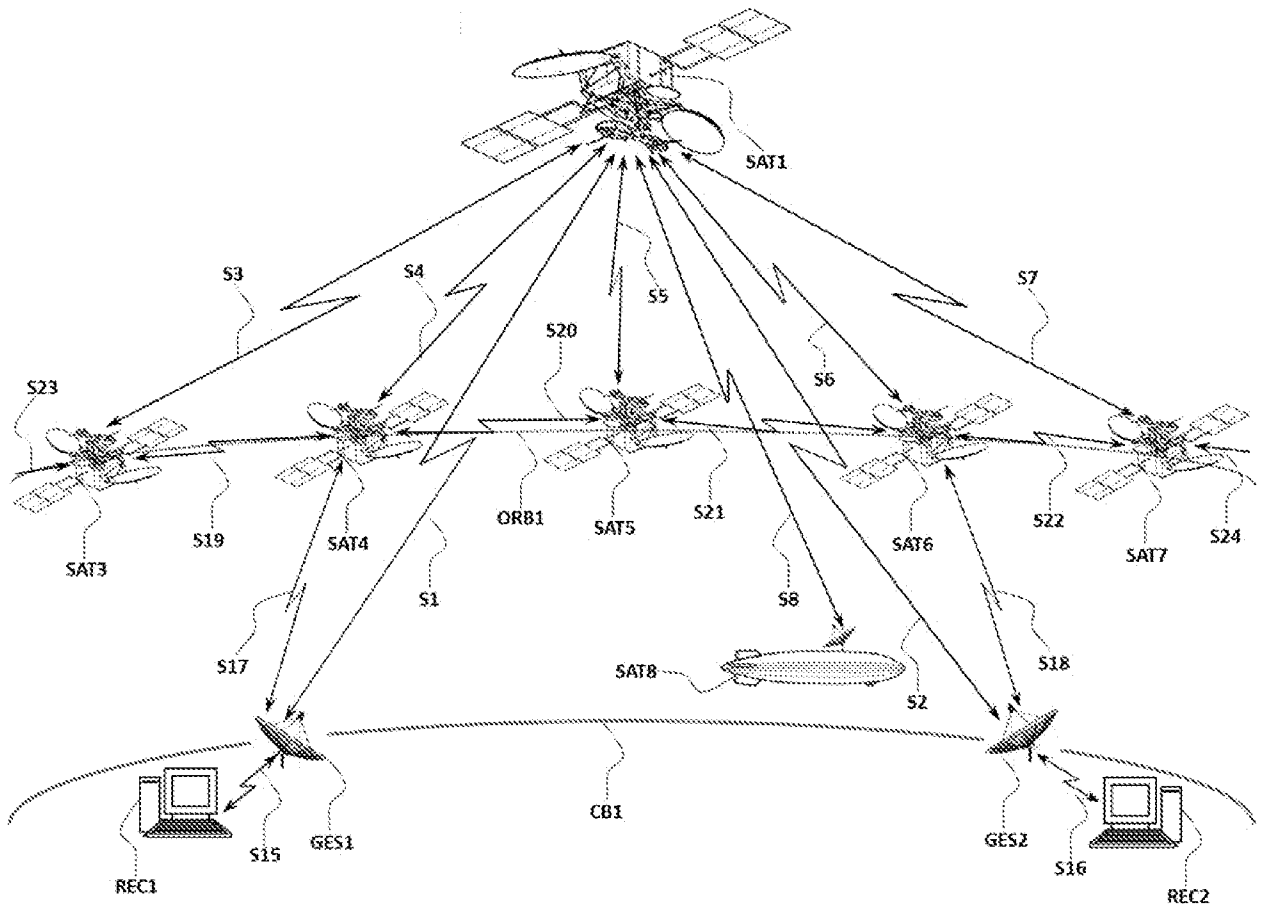


FIG. 1

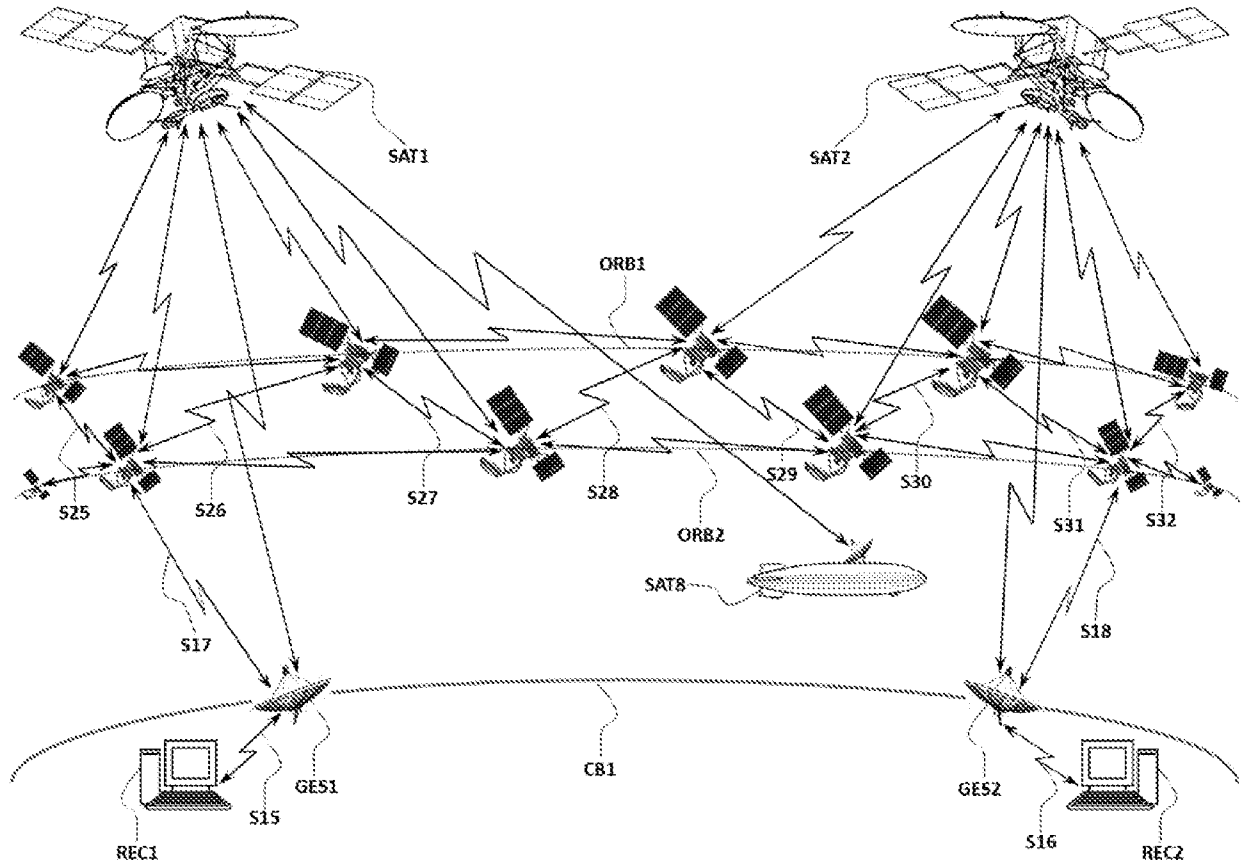


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/16467

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H04W 84/06; H04B 7/185, 7/19 (2016.01) CPC - H04W 84/06; H04B 7/185, 7/18521 According to International Patent Classification (IPC) or to both national classification and IPC</p>														
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8): H04W 84/06; H04B 7/185, 7/19 (2016.01) CPC: H04W 84/06; H04B 7/185, 7/18521</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google Scholar; EBSCO; IP.com Keywords: Satellite Space-Based Array Grid Network Storage Terrestrial Earth Ground</p>														
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:10%;">Category*</th> <th style="width:70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width:20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2014/0341586 A1 (1110 VENTURES LLC) 20 November 2014, Figures 1, 5, Abstract, paragraphs [0003], [0018], [0027], [0030], [0035], [0037], [0048]-[0050].</td> <td>1-3, 5</td> </tr> <tr> <td>A</td> <td>US 6,002,916 A (LYNCH, W) 14 December 1999, Entire Document.</td> <td>1-3, 5</td> </tr> <tr> <td>A</td> <td>US 2001/0013566 A1 (YUNG, K et al.) 16 August, 2001, Entire Document.</td> <td>1-3, 5</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2014/0341586 A1 (1110 VENTURES LLC) 20 November 2014, Figures 1, 5, Abstract, paragraphs [0003], [0018], [0027], [0030], [0035], [0037], [0048]-[0050].	1-3, 5	A	US 6,002,916 A (LYNCH, W) 14 December 1999, Entire Document.	1-3, 5	A	US 2001/0013566 A1 (YUNG, K et al.) 16 August, 2001, Entire Document.	1-3, 5
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p>														
<p>* Special categories of cited documents:</p> <table style="width:100%;"> <tr> <td style="width:50%;"> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width:50%;"> <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&” document member of the same patent family</p> </td> </tr> </table>			<p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p>	<p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&” document member of the same patent family</p>										
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<p>Date of the actual completion of the international search</p> <p>29 March 2016 (29.03.2016)</p>		<p>Date of mailing of the international search report</p> <p align="center">20 JUN 2016</p>												
<p>Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300</p>		<p>Authorized officer</p> <p align="center">Shane Thomas</p> <p>PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>												

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/16467

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: 4, 6-19, 21-33, 35-67
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-3, 5

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

-Continued from Box No. III Observations where unity of invention is lacking -

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-3 and 5 are directed towards a space-based electronic data storage and transfer network system comprising an access terminal configured to transmit a file.

Group II: Claim 20 is directed towards a satellite data network comprising a plurality of storage satellites wherein the storage satellites are coupled through a continuous loop of relays.

Group III: Claim 34 is directed towards a space-based electronic data storage and transfer network system comprising a second power system powering a third communications array.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include an access terminal located on the Earth, the access terminal including at least one terminal communications array configured to transmit a file, which are not present in Groups II-III.

The special technical features of Group II include communicating with an authorized outside satellite that is not a storage satellite; and wherein the storage satellites are communicatively coupled to each other through a continuous loop of relays between consecutive storage satellites, which are not present in Groups I and III.

The special technical features of Group III include a second power system comprising a second power source and a second energy storage component capable of storing energy received from the second power source; a third communications array powered by the second power system and coupled to both the second communications array of the communication satellite and the third communications array of other storage satellites; and a processor configured to record data from uploads received by the third communication array to the at least one data storage element and retrieve data from the at least one data storage element in response to data requests received by the third communication array, which are not present in Groups I-II.

The common technical features shared by Groups I-III are a space-based electronic data storage and transfer network system comprising: a first storage satellite including a power system and at least one first satellite communications array configured to receive the file from the access terminal, the at least one first satellite communications array being communicatively coupled through a first processor to at least one first data storage element, the at least one first data storage element being configured to record the file to the first data storage element; and a power system comprising a power source and an energy storage component capable of storing energy received from the power source.

However, these common features are previously disclosed by US 2014/0341586 A1 to 1110 VENTURES LLC (hereinafter "Ventures") Ventures discloses a space-based electronic data storage and transfer network system (transmit (transfer) user data in a satellite constellation (network), RAM 506 (storage) within each satellite holds user data; Abstract, paragraphs [0048], [0050]) comprising: a first storage satellite including a power system and at least one first satellite communications array configured to receive the file from the access terminal (each satellite has a 180W battery (power system), memory 506 (storage), satellites 200 contains RF links (satellite communication array) allowing transfer of user data with the user terminal; paragraph [0018], [0035], [0048], [0049]), the at least one first satellite communications array being communicatively coupled through a first processor to at least one first data storage element (RF satellite comprises computer system 500 where user data is stored in RAM 506 (data storage element) coupled to CPU 502 (processor), RF links (communications array) receive (communicatively coupled) user data; Figure 5, paragraphs [0018], [0048]-[0050]), the at least one first data storage element being configured to record the file to the first data storage element (RAM 506 (data storage element) can hold user data (file); paragraph [0050]); and a power system comprising a power source and an energy storage component capable of storing energy received from the power source (satellite comprises a battery having energy storage suitable for providing power; paragraph [0035]).

Since the common technical features are previously disclosed by the Ventures reference, this common feature is not special and so Groups I-III lack unity.