CLAIMS

What is claimed is:

1. A storage system, said storage system comprising:

a gridded three-dimensional structure, said gridded three-dimensional structure comprising:

a gridded lower track layout occupying a two-dimensional area and on which storage/retrieval vehicles are conveyable in two directions over said two-dimensional area;

a plurality of storage columns residing above the gridded lower track layout in spaced distribution over the two-dimensional area of said gridded lower track layout, each column comprising a plurality of storage locations arranged one over another and sized to accommodate placement and storage of storage units therein;

a plurality of upright shafts residing above the gridded lower track layout in spaced distribution over the two dimensional area of said gridded lower track layout, such that each of the storage columns is neighboured by a respective one of the upright shafts through which the storage locations of each of said storage columns are accessible by the storage/retrieval vehicles to place and remove the storage units to and from said storage locations of each of said storage columns;

at least one working station residing alongside the gridded three-dimensional structure and outside the two-dimensional area of the gridded lower track layout over which the storage columns and upright shafts are distributed, said working station joined to the gridded lower track layout by an extension track thereof by which said storage/retrieval vehicles are conveyable between said working station and said gridded lower track layout, said storage/retrieval vehicles driven through the working station in a unidirectional manner from an entrance spot thereof to an exit spot thereof, thereby allowing multiple storage/retrieval vehicles to be queued inside said working station, thereby reducing traffic obstruction on said gridded lower

track layout;

and wherein said extension track is connected to the gridded lower track layout in a position running alongside the gridded track layout, thereby allowing a seamless transition of said storage/retrieval vehicles between said gridded three-dimensional structure and said working station, and wherein conveyance of the storage units between the storage locations and the working station is performed entirely by said storage/retrieval vehicles, thereby freeing said storage system of conveyors operating between said gridded three-dimensional structure and said working station; and

at least one processor configured to identify from among said storage/retrieval vehicles, a first storage/retrieval vehicle of a higher ranked sequence priority than a second storage/retrieval vehicle, said processor configured to:

generate signals instructing the second storage/retrieval vehicle to park itself in the gridded three-dimensional structure at a parking spot of non-obstructive relation to the extension track while the first storage/retrieval vehicle is conveyed along the gridded lower track layout to said extension track of said working station;

determine said parking spot based on a least-distance travel path to an entrance spot of said working station from one of designated spots at which said second storage/retrieval vehicle arrived at said gridded lower track layout.

2. The storage system of claim 1, wherein the working station is configured to be served solely by the extension track and the storage/retrieval vehicles conveyable thereon.

3. The storage system of claim 1, wherein said extension track is connected to the gridded lower track layout of the gridded three-dimensional structure at two opposing ends of said extension track, whereby each of the storage/retrieval vehicles is configured to traverse the extension track in a direction emerging from the gridded three-dimensional structure at one end of the extension track and re-

entering the gridded three-dimensional structure at another end of the extension track.

4. The storage system of claim 1, wherein the extension track is at least partially enclosed.

5. The storage system of claim 1, wherein the extension track is configured to pass through the working station from the entrance spot situated at or adjacent to one end thereof to an exit spot situated at or adjacent to an opposing end thereof.

6. The storage system of claim 1, wherein the working station comprises an enclosure into which the extension track extends from the gridded lower track layout.

7. The storage system of claim 1, wherein the working station comprises an access opening served by the extension track and through which a storage unit carried on one of the storage/retrieval vehicles is accessible when said storage/retrieval vehicle carrying said storage unit reaches said access opening of the working station.

8. The storage system of claim 7, wherein said working station comprises a countertop penetrated by the access opening, and said extension track is configured to run underneath said countertop.

9. The storage system of claim 1, wherein said storage system comprises a plurality of working stations, each linked to the gridded lower track layout by a respective extension track.

10. The system of claim 1, wherein said processor is configured to organize sequenced delivery of a group of storage units from the three-dimensional gridded structure to the working station, said processor configured to:

(a) generate signals to instruct said storage/retrieval vehicles to retrieve the storage units from respective storage locations; and

(b) generate signals to instruct said storage/retrieval vehicles to navigate the three-dimensional gridded structure in a manner orchestrating arrival of said storage/retrieval vehicles at the extension track in a particular sequence;

wherein said particular sequence does not always match:

a sequence in which the storage units were retrieved by said storage/retrieval vehicles;

a sequence in which said storge/retrieval vehicles landed at said gridded track layout; and

a sequence in which said storage/retrieval vehicles arrived at a vicinity of an emergence spot located adjacent to said working station.

11. A storage system, said storage system comprising:

a plurality of storage/retrieval vehicles; and

a gridded three-dimensional structure, said gridded three-dimensional structure comprising:

a gridded track layout that occupies a two-dimensional area and on which the storage/retrieval vehicles are conveyable in two directions over said two-dimensional area;

a plurality of storage columns residing above or below the gridded track layout in spaced distribution throughout the two-dimensional area of said gridded track layout, each column comprising a plurality of storage locations arranged one over another and sized to accommodate placement and storage of storage units therein, and wherein said storage/retrieval vehicles travel horizontally in said two directions on a gridded upper track layout disposed above the storage locations and on a gridded lower track layout disposed at a ground level and below the storage locations;

a plurality of upright shafts residing above or below the gridded track layout in spaced distribution within the two-dimensional area of said gridded track layout, such that each of the storage columns is neighboured by a respective one of the upright shafts through which the storage locations of each of said storage columns are accessible by the storage/retrieval vehicles to place and remove the storage units to and from said storage locations of each of said storage columns;

at least one working station residing outside the two- dimensional area of the gridded track layout within which the storage columns and upright shafts

are distributed, and wherein said working station is joined to the gridded lower track layout by an extension track, and wherein conveyance of the storage units between the working station and the storage locations in the gridded three-dimensional structure is performed solely by said storage/retrieval vehicles, thereby freeing said storage system of conveyors operating between said three-dimensional structure and said working station; and

at least one processor configured to identify from among said storage/retrieval vehicles, a first storage/retrieval vehicle of a higher ranked sequence priority than a second storage/retrieval vehicle, said processor configured to:

generate signals instructing the second storage/retrieval vehicle to park itself in the gridded three-dimensional structure at a parking spot of non-obstructive relation to travel of the first storage/retrieval vehicle to said working station;

determine said parking spot based on a least-distance travel path to an entrance spot of said working station from one of designated spots at which said second storage/retrieval vehicle arrived at said gridded lower track layout;

and wherein said storage/retrieval vehicles are driven through the working station in a unidirectional manner from said entrance spot to an exit spot of said working station, thereby allowing multiple storage/retrieval vehicles to be queued inside said working station, and thereby reducing traffic obstruction on said gridded lower track layout.

12. The system of claim 11, wherein said processor is configured to organize a sequenced delivery of a group of storage units from the three-dimensional gridded structure to the working station, said processor configured to:

(a) generate signals to instruct said storage/retrieval vehicles to retrieve the storage units from respective the storage locations; and

(b) generate signals to instruct said storage/retrieval vehicles travel to

navigate the gridded three-dimensional structure a manner orchestrating arrival of the storage/retrieval vehicles at the working station in a particular sequence;

wherein said particular sequence does not always match:

a sequence in which the storage units were retrieved by said storage/retrieval vehicles;

a sequence in which said storge/retrieval vehicles landed at said gridded track layout; and

a sequence in which said storage/retrieval vehicles arrived at a vicinity of an emergence spot located adjacent to said working station.

13. A storage system comprising:

a plurality of storage/retrieval vehicles;

a three-dimensional structure comprising a three-dimensional array of storage locations sized and configured to accommodate placement and storage of storage units therein;

at least one working station to which storage units from the storage locations are conveyable by said storage/retrieval vehicles, wherein said working station comprises:

an enclosure through which said storage/retrieval vehicles are conveyable; and

an access opening in said enclosure through which a storage unit carried on one of the storage/retrieval vehicles is accessible when said storage/retrieval vehicle carrying said storage unit reaches said access opening of the working station;

wherein said working station is connected by an extension track to a gridded lower track layout on which the storage/retrieval vehicles are conveyable, and wherein storage units are conveyed between the working station and the storage locations solely by said storage/retrieval vehicles, thereby freeing said storage system of conveyors operating between said three-

dimensional structure and said working station;

and wherein said storage/retrieval vehicles are driven through the working station in a unidirectional manner from an entrance spot of said working station to an exit spot of said working station, thereby allowing multiple storage/retrieval vehicles to be queued inside said working station and thereby reducing traffic obstruction on said gridded lower track layout; and

at least one processor configured to identify from among said storage/retrieval vehicles, a first storage/retrieval vehicle of a higher ranked sequence priority than a second storage/retrieval vehicle, said processor configured to:

generate signals instructing the second storage/retrieval vehicle to park itself in the gridded three-dimensional structure at a parking spot of non-obstructive relation to the extension track while the first storage/retrieval vehicle is conveyed along the gridded lower track layout to said extension track of said working station;

determine said parking spot based on a least-distance travel path to an entrance spot of said working station from one of designated spots at which said second storage/retrieval vehicle arrived at said gridded lower track layout.

14. The storage system of claim 13, wherein said entrance spot and said exit spot are located at opposite ends of said enclosure, and wherein said storage/retrieval vehicles travel past said access opening during conveyance between said entrance spot and said exit spot.

15. The storage system of claim 13, wherein said working station comprises a countertop penetrated by the access opening, and said enclosure runs underneath said countertop.