(Note to reader: There are several inventions in this one ‘provisional-document’. For each section with its on Title, if there is reference to ‘document’ it refers to that titled section only and not to the provisional-document.)

# Contents

Remarks: Some of the words and phrasing used in these documents may not be as known and used in the respective engineering, mechanics, programming and aeronautics industries.

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By Michael Chung

# **Title: Methods, systems and apparatus for autonomous robot platform - for assisting small airplanes to land, takeoff and move; also for cargo carts and passenger pods; and related, for airports; and control and management of driverless for hire or mass transit vehicles at their depots and passenger stops.**

Inventor: Michael Chung.

Aristides Simonides. Illustrations; co-inventor of electromagnetic means for landing gearless craft Fig 8.

## Invention background, summary, etc.

Methods, systems and apparatus for robot platform for carrying and moving about small airplanes and automating takeoffs, landings and movements for small airplanes (crafts), especially small vertical and/or short take-off and landing (V/STOL) pilotless or piloted passenger crafts; also for robotic cargo carts and passenger seat pods; and a variant for ground vehicles, especially the driverless for hire or mass transit to control and manage the vehicle movements at depots and passenger stops.

The platform mechanics: An electrically-powered, 4-wheel, aircraft catcher, carrier, and catapult.

The invention includes assisting airplanes (‘craft/s’) in particular the envisioned pilotless Sky Taxi* crafts - to move, land and takeoff at their designated airports. It includes the airport system to provide and enable such activities.

This document focuses on pilotless crafts (including drones, both civilian and military) and passenger related activities. However, the invention includes adaptions for ground vehicles, especially driverless for hire; as well as other automations for a small airplane such as loading/unloading pods that have seated passengers; as well as extending the automation to have driverless luggage carts able to go to the larger airplanes to have their luggage loaded/unloaded; etc.

*A preferred embodiment for the small airplanes is a wheeled robotic platform onto which the airplane will land on* or after landing to be loaded onto, then the platform will ferry/carry the craft to the passenger embarking areas, even do some maintenance ‘in route’ such as charging/swapping the craft’s batteries, also to the maintenance areas if needed, then for the take off to carry the craft to the runway, and accelerate down the runway, turn on the active noise cancellation system on the platform or on the airport grounds to offset the propulsion sounds and optionally tilt the bed of the platform to assist in the take off. *Either the craft will control the platform for the landing phase, or the platform and the airport will control the craft in order for the platform and the craft to mate (in addition, there is a ‘override switch and decision loop’ for the platform to stop or move out of way and the craft to either break off the landing for another attempt or to directly and normally land on the tarmac, the override can include to call for human operator at the airport or the craft’s operation center to take over or decide), also a part of the bed of the platform (which has the craft’s front wheel on it) can rise up and raise the nose (if desired) of the craft say from 5 to 10 degrees if such will improve its takeoff profile and reduce power load on craft’s propulsion system.*

*A craft (e.g., a VTOL) that will exclusively use the platform to take off or land would not need landing gears, and could have a skid system and save weight and power.*

*Also, the fixed wing Sky Taxi crafts are envisioned to be landing near their stall speeds of approximately 35 mph. An alternate means for loading the craft to the platform is for an extended arm from the platform to grab a bottom part element of the craft and to bring it to it.*

*Also, the bed of the platform can be designed, alternatively, to rise several feet into the air, and also to angularly tilt if desired, or while flat move side to side or forward and backwards (in relation to the platform), so that it can better mate to the landing movement of the craft, and once the craft touches say three points on the elevate-bed and the bed senses the force of the craft, then the bed can start to lower the bed to the platform.*

*Also, the top of the platform or its bed (interchangeable) can have grooves for rain to roll off faster; or even be honeycombed for rain to pass thru; grooved to better adhere the craft wheels to its surface; heated for snowy/ice conditions – and thus, with added springs on the platform for cushion, and perhaps with appropriate sized large and textured wheels, the platform may compensate for rough spots on the runway, bad weather, and even on 'dirt' runways. A bit like a single airplane aircraft carrier, for land or sea uses.*

## About the sky-taxi:

'…an aerial taxi service that would eventually become fully autonomous, hauling people on short-to-medium range trips in small, electric aircraft that would fly out of very small airports…' http://sustainableskies.org/eas-ix-dr-seeleys-magnum-opus/

'Future, on-demand, electrically-powered Sky Taxi aircraft must be able to deliver both people and packages at high proximity 'pocket airparks' that minimize the length of 'last mile' surface travel for the short-range trips that people most often make. These are sub-100 mile trips that stay within metropolitan 'mega-regions'.' (Dr. Brien Seeley, CAFE Foundation, Regional Sky Transit)

'Electric propulsion offers the following unique capabilities that other propulsion systems can't provide for short range Vertical Takeoff and Landing (VTOL) aircraft; elimination of engine noise and emissions.' Mark Moore. NASA Puffin Electric Tailsitter VTOL Concept.

Such crafts are for shorter hops, the airports to be located in closer proximity to human habitats, to have increased flight cadence (even as frequent as 10 seconds* – e.g., for 2 passenger crafts), and eventual pilotless, etc. *Dr. Brien Seeley, Regional Sky Transit

Until now the designs for the Sky Taxi crafts envision them moving, landing and taking off on their own power and with 'conventional' airport ground behaviors/actions.

For example, for takeoff the electric powered platform can accelerate from 0 to 60 mph in 60 yards moving a total mass (the platform and craft) of about 5,000 lbs. at about 1 G. The crafts are expected to be about 1,800 lbs. empty.

*An invention thesis is to 'offload or delegate' to automate with robotics, AI and 'smart systems' as much as practical to the ground based support, assistance and the local system. The invention envisions to assist in the moving, landing and taking off activities so that, the burden on the crafts own systems, power and the craft's noise factors are reduced as well as in cadence.*

*Also, it teaches how the local system (the airport; or the bus stop for ground vehicles) can more efficiently command and control the vehicles coming into its area of control.*

*For this, the invention teaches an 'API' type of strategy so that the common resource (i.e., the airport, battery charge stations for ground vehicles) can be more efficiently be set up to be used by various third party transportation services including driverless ground vehicles for hire (Uber, Didi, Google, etc.). The software, systems and protocols can model the API model, not just in data and software resources but in the protocols and rules of determining and giving 'command and control' between the station/airport, the platform and the craft.*

## The goals of the platform for the airplane crafts invention include

- Reduce the power needs of the craft to take off by assisting the craft to reach flight speed and angle, and the optimum direction into the wind.
- Reduce the wear on the craft's mechanical systems, the complexity of its own self-guiding software and manpower.
- Assign 'as much' of the craft's ground-movement, takeoff and landing tasks to the ground system in order to reduce the burden of the craft.
- Improve the cadence of the flights, including to use swarm intelligence of all the crafts in its area of responsibility and control.
- Improve safety – as the local system ought to be much more aware of the environment, even the conditions of its runway (e.g., a cracked area to avoid), respond to non-orchestrated (e.g., emergency) events faster.

## The invention highlights, variations, others

Invention will be highly dependent on the AI, self-driving robotics and software systems, LIDAR; sensors, and location and environment aware solutions. The more these systems are mature the more the reliance, the more the invention's automation – i.e., so that the airport and the crafts can be a bit analogous to automated package or containers handling system.

### *1. A semi/autonomous robotic wheeled and motorized platform-cart/vehicle…*

(referred as platform in this document) onto which airplanes (crafts) can land on or take off from and to be ferried about. This system will require the airport, the platform and the crafts and vehicles, pilotless or piloted to have the invention system and to cooperate with each other. The platform's features include:

a) The platform or its top (the bed) onto which the craft can land onto, be loaded onto (from the runway, tarmac), and optional means to elevate the front wheel of the craft to improve its angle of attack at takeoff.

b) The entire system can utilize one or combination of the wheeled platforms or ground mounted tracks for the platform (e.g., conveyor systems, or where the platforms or beds are mounted on the ground or an in-tarmac elevator (referred to as platform-elevator later in this document) to raise and lower the platform.

c) Guiding means for the platform such as beacons, sensors, camera recognizable images, etc. are placed at appropriate spots such as the edges of the runway, the turning areas, the path to the docks, dock area, path to the maintenance areas, etc. These are in addition to what is on the platform and the craft. The platform and craft will each monitor their environment and the actions of other, where the craft (when on the platform) could override an action by the platform, etc.

d) The platforms can be built into the driveway, e.g., for personal VTOL crafts that may be housed at the homes of the owners.

e) Noise cancellation systems can be mounted on the platform (or in combination with ground based systems, e.g., sensors or speakers near the perimeter of the airport) to reduce noise and sound to the habitations nearby.

f) The platform can have certain additional designs to aid in the aerodynamics of the take offs and landings – i.e., to raise the nose of the craft.

g) The inventor envisions the platform to be autonomous in doing their instructed task, however they can be instructed, steered and otherwise commanded or overridden, remotely by human operators who may be on the tarmac, in the platforms' airport command center, or even by the operation center of the presently being-ferried craft. Such remote system and interface can be a console, on a tablet, or via headset with voice commands (e.g., to speak commands such as 'stop', 'now proceed at 3 mph to bay 6 by way of the lane 9'.

*2. The invention includes modification to the airport itself…*

e.g., in the physical infrastructure (placing sensors, machine readable signage, etc.), the command, control and communication system, and the software and hardware for the invention ferrying system (i.e., the platform, docks for the platform, conveyors for the passenger pods, etc.). These include:

h) Software, systems (e.g. AI, LIDAR, Sensors) and protocols for the airport and the platform/s and the crafts to synchronize with each other including the protocols and software and their processes to hand off control and to coordinate with each other.

i) LIDAR, radar and/or cameras are mounted on the platform and the craft so that they will be able to see each other, gauge each other location, orientation, angle of approach and momentum and for the platform and craft to mate.

j) There can be markings on the craft and the platform for them to orient, know the distance, etc. to better meet each other.

k) The location sensing and tracking by and of the platforms, crafts and the airport (to determine the location, motion, momentum and orientation of the platforms and crafts) will utilize from among the current arts. These include radio transponders, beacons, GPS, accelerometers, markings on the tarmac or roads or signs and images recognizable by camera, perhaps infrared, sounds (non-human audible), LIDAR, radar, etc.; third party data such as GPS coordinates; their respective software; and AI and robotics (e.g., Robot Operating System); etc.

l) The invention envisions to 'tag all' of the workers, equipment, vehicles, etc. by using tracking and identification and their respective software and management solutions. The reasons include for safety (and to aid in the platform and the crafts navigation on the tarmac) of the human workers and other robots, equipment, crafts, carts (e.g., baggage and containers); manned or driverless trucks and service vehicles; mounted in-ground things (signs, lamp posts, airport walls, etc.); etc. that are moving/roaming about on the tarmac. Also, some objects may have more than one tag (e.g., a truck can have on each of its corners). Thus, each object/thing (mobile, stationary or mounted in-ground) is in awareness of another; and additionally where there can be rankings of overrides, control and prioritization, for example the platform can give higher weight (to the stimuli) to decision from an object wearing the 'human worker' tag which unplanned may be in its path; or the platform will yield the right of way to a firetruck.

   i) For example:

(1) Human and robots (robotic service workers, etc.) will wear radio tags to identify them; they may further have machine recognizable images on their uniforms as back up to the radio tags.
(2) The platforms; trucks; baggage handling conveyors; fire trucks; third party service vehicles; etc. will have such.

*3. Pods-platform for passengers and cargo and means…*

for such to move, be conveyed, placed and secured into and out of the small crafts – where for example, the passengers are pre-boarded* (i.e., seated) at waiting areas onto the pods and then the pods are moved into the crafts. A benefit is that there is time savings and increased safety as the passengers do not have to walk to and board onto the craft (e.g., smaller crafts may be bit harder/intimating to board for certain passengers).

m) *The pods can additionally have means to collect or confirm fares and the identification of the ticket holder, so that, on a smartphone application a passenger will see the flight and seating availabilities, purchase; then at the pod have the QR code scanned by the said fare means.
n) This fare means assembly can be in the arm rest of the seat. Also there are display means (images, speakers (to communicate to each passenger or optionally via BLE to their smartphone app.
o) If desired to confirm the identity of the passenger, biometrics (eye scan), thumb or palm print, scanning of radio tag/s in their body, etc. can be mounted in the pod, in the armrest, etc.
p) The pod is generally open, including the top; and the sides may or may not have doors per se to give the feel of still being in the waiting area. However, there are expected to be bars for grabbing, hand/and side rails. The seats have belts, rated for airplane safety, etc.
q) Scale – the pod (and each seat) will have a weight monitoring means to know the respective weight.
r) Others: Passenger controlled stop button; various safety means – before pod moves, 'is the passenger buckled and/or pressure/weight sensors (of the seated passenger) in the seat bottom and backside at correct reading', is the gate to the pod locked; various feedback means (audio and/or visual) to the passengers of the status.
s) Means to move the pod include a robot tug attached to the rear of the pod or a rhomba like robot to be under the pod and which additionally, can lift the front wheels of the pod off the pavement and steer it.

*4. Autonomous/Robot cart system for airports: cargo carts, container carts, mobile passenger stairs, etc.*

t) A robotic platform-cart (robotic cart), configured to carry the luggage/baggage or containers (per the use case) that will move about - on its own power and be used singularly or in groups (i.e., the robotic carts are optionally 'electronically tethered' to each other to keep a certain range of distance to each other, e.g., one to the 'rear' of the robotic cart in front of it) without the use of a hitch or a tow bar.
u) For uses such as:
    i) Ferrying the baggage of the passengers to and from the airplane to the baggage loading or unloading areas.
    ii) Ferrying the cargo containers (carried in the airplanes), to and from the airplane to the container loading/unloading areas.

v) (In general, this invention part teaches the use of robotic carts for ferrying cargo on airport tarmac so that the driver is not needed.)

*5. Other invention variations, systems and embodiments include…*

w) For a ground vehicle version of the invention: A bus stand/stop or taxi station system (collectively station) where the station takes control over (or has areas of control, overriding the vehicle system) the vehicle when it enters the station area as the station can have more situational awareness and 'has responsibility' for the station.

   i) The invention system includes uses where the driverless taxi and bus move about at the taxi stand or bus stop (the stations) - but where the above mentioned platform or tug component of the invention (for the airplanes) is not to be generally used as the vehicle itself is a ground vehicle.

      (1) However, the invention's software, hardware, sensors, its AI, protocols, etc. can be modified to be used for controlling the driverless taxi or bus at the stand or stop. They will communicate with each other, handshake, etc. and to temporarily allow the stand or stop (aka station master system) to 'take over control' over the vehicle/s when the vehicles are in the 'station zone'.

      (2) The thesis is that the local station's AI or intelligence can be more aware of its station environment or has newer information, and that the 'station master' can better manage the traffic and passengers (loading or offloading) especially if multiple driverless vehicle services are using the stations.

x) For battery charging or swapping station: A system for managing and controlling a group of vehicles at a battery charging or swapping station – by having the station to temporary take over the control of the vehicles in the zone. Where the station takes over control over the vehicle while at the station including to move them to the charging stations and then to move them away when done, etc. This system can substantially use the preceding systems and methods for the taxis and buses.

   i) E.g., a driver will drive his electric vehicle to his commuter railroad station (or sky taxi airport) and drop it off near the charging station (or even at the 'passenger drop off area of the commuter station) and go to work. His vehicle will be 'automatically' moved to the charging station while he is at work, then at end of day he will pick up his car at the regular parked area.

   ii) E.g., where the electric vehicle (driverless or with driver) comes to a charging station – the invention teaches where the charging station 'takes control' over the vehicles to cause them to be moves to charging dock (where the chargers are) and then after charging, will move the vehicle away from the charging dock to a parking area where the vehicles can be then found by their owners and driven away. Also, instead of charging, the station can be for battery swapping.)

   iii) There will be provision and protocols for the vehicle to allow the station to have limited control over it. These can include being located in the station area, the driver having given such permission, and the vehicle system to allow the station system to have certain and limited operational control over it (e.g., access to the motion controls, even maintenance logs but not to the vehicle personal spaces such as the trunk and interior).

   iv) The vehicle will yield limited and agreed to 'jurisdiction' or control over itself at the charging station to the station master. This control includes control over its movement system to allow the station master AI to instruct the vehicle to be moved.

*6. A tug means - instead of the platform…*

for certain activities such as for personal piloted airplanes (e.g., smaller types) at 'regular' airports – where the crafts will roll on to the platform or be made to attach to a tug after landing so that the platform/tug will ferry the craft to its parking area, hanger or dock without manual guidance by the pilot or power by the craft.

y) Benefits: Recreational pilots can fly into unfamiliar airports. After landing, the pilots are responsible to correctly follow the turns and paths; look on the airport map ('resting on their laps', etc.) and taxi the craft. With the invention, the pilot once landed, need not do anything other than to direct the craft on/to the platform/tug. Then, the platform will take over and ferry the craft to where it is supposed to go. If a tug is used – it can attach to the front wheel assembly or tow a carriage for the front wheel to roll onto to it (e.g., a cradle/hitch for the front wheel). The tug is power and self-guiding.

z) (Note: This tug-part of the invention is covered in part/perhaps substantially by the prior art ---- US 2013/0333971, a towbarless robotic airplane tug:

   i) 'The present invention relates to novel robotic tugs for taxiing airplanes from a gate to a take-off runway without using the aircraft jet engines. In accordance with a preferred embodiment of the present invention, the robotic tugs preferably operate in an airplane pilot-controlled taxi mode wherein the airplane pilot steers and brakes as if the airplane were moving under its own engine power and the tug speed is controlled by a controller. Upon completion of the airplane taxi the tug preferably returns autonomously to a pre-pushback location at the gate, controlled by an airport command and control system. Preferably, a tug driver performs the pushback operation, after which he leaves the tug and the airplane pilot controls the tug during taxi. In accordance with an alternative embodiment of the present invention, the tug may operate in an autonomous mode of operation during airplane taxi. The term "autonomous" is used throughout in a broad sense to include operation under the control of an airport command, control and communication system, preferably subject to airplane pilot override.'

   ii) In general the above prior art is related to assisting the airplane from the pushback to the taxiing and where the tug lifts and controls the front wheel assembly.

## Figures descriptions, some prior arts

### Fig 1 – The platform

Is a robotic platform with bed on a chassis mounted on a plurality of wheels, at least some of said plurality of wheels being steerable wheels; the platform able to carry and support a small craft; has power (e.g., battery).

The platform's frame/chassis is mounted with the various systems typical for self-driving or remote controlled ground systems, including: motors for the various functions and uses such as for the locomotion, the rails wheels, the platform's ramp/lifts means; computer and various software for the platform's operation, AI; housings (2a) for the various LIDAR, sensors, GPS, communication; noise cancellation system (9), software and protocols to sync the platform, with the craft's system and the airport's, etc. Has the optional special markings to additionally help the craft's cameras to 'see' the platform and its bed for judging the orientation, speed, in the mating as part of the process for the craft and the platform to meet; similar components are on the craft as well.

Preferably, as much as possible the battery, housing (2a), computer, hydraulics, etc. are mounted at the chassis side – in order that the platform is thin as possible so that it can optionally can be lowered to the ground (e.g., using such as the Tesla car like smart suspension) in order for a craft on the tarmac to more easily roll onto or be loaded to the bed. In the alternative, a ramp is mounted on the platform for the craft to roll on.

Also, another way (Fig 2) to lower the bed is that there can be a spur or 'jug handle' from the runway where the platform will be waiting, and the craft will load onto the platform. At the jug handle there are recessed furrows/channels (say, each is about the 'width' of the wheels of the platform, and are spaced the same distance as the wheels are spaced, and in parallel so that, that platform will roll down into (or back into) it so that, the top of the bed is at the same level as the tarmac to allow craft to roll on to it.

Also for the Fig 2, multiple platforms can be lined up in the spur, end to end with no gaps, and wait for the crafts to load on to them; and which point the platform will move out of the burrow and spur and onto the tarmac and to the docks.

1- The platform chassis and steerable wheels, onto to it is attached/mounted: battery; computer with operating system (e.g., Robot OS (ROS)), machine vision; various motion and image recognition means, sensors, cameras; active noise cancellation; various mechanical means (suspension, hydraulics); etc.
2- Is the bed on which the craft is carried, has means for loading/unloading the craft on the tarmac to the bed; it can be separate from the main platform's chassis or the upper part of the chassis can be used as bed; if separate, the bed can have hydraulic means to tilt, angle, and move.
3- A datable and swappable 'equipment' container – i.e., the 'box' can contain different tool and functional apparatus. In this image it is a ramp and lid with the lid lifting means shown in the inner area. E.g., as a ramp: Some crafts may land directly on the tarmac and then be made to be loaded to the platform. There is a ramp for the craft to mate with or roll on to, so that, the craft can be loaded to the platform. Loading is by several alternatives. Pulling up by grabbing or locking onto the front wheel. Also, the craft's wheel/s may be motorized to be used to roll on to the platform. (6) is the battery, however, the battery can be moved to the space between the rear and front wheels on each side – for the purpose to have 2 such boxes on the platform, one on each end and for different functions (ramp and one it for assisting the landing (Fig 3 and 8)
4- Is a means for securing the front wheel of the craft and to lift it (e.g., to assist in the take-off), and if desired, can have channel in the bed and pulling system mounted to the ramp-box.
5- Is the guide channel for the front wheel assembly.
6- Is the battery or power source for the platform and its various systems, and also if to recharge the craft via robotic arms (not shown) which will connect to the power port of the craft.
7- Is the active noise cancellation system and microphone, vibration or sound sensor array.
8- (Not shown) Is the noise or sound absorbing materials, shapes and design; optionally, the bed of the platform can have noise absorbing materials, to have honeycombed type of grating (if so, then as to not have the craft's tires to come into contact with it, such to be appropriately placed and/or to provide special surface areas where the wheels would touch in the platform, etc.

9- Not shown are the related airport systems, sensors and guides in the ground, tarmac markers, battery swapping system (e.g., a battery swapping system can be installed on the platform), etc.

*The 'ramp assembly' in Fig 1 can be swapped out for differently configured functions…*

(This section is being added after the document was mostly completed.) BTW: the platform is bidirectional where either end can be used for the front or back, so that, if the ramp assembly is needed to lift and load a craft on the tarmac, it can be swapped out.

Also, in fact there can be 2 different 'ramp assembly' on the platform. One for loading the craft (the ramp lid will lower to ground, and there is a wrenching means in the ramp area or compartment); and one for assisting in the landing-touch-down of the craft, as the following:

*A ramp assembly and system for crafts to land on the platform:*

This ramp is at the 'front' and the following describes for a craft to land on the platform.

As the craft get close, the ramp lid can be raised at say 45 degrees or higher so that, when landing the front wheel (or skid/leg) of the craft will first make contact with the ramp lid; the ramp lid has sensors in the top surface as well as in the hinges* and/or its hydraulic (or other lifting means) so that, the force and momentum and angle of the craft can be inferred. (Btw: after the first touch of the wheel to the ramp, it may bounce off and then touch again, etc. and this needs to be part of the computation.) *Thus, the hinges may be preferably 'not machined tight' but to have some give so that lateral force (also 'twisting') can be measured and felt by such sensors on the lid top, the hinge area, the platform and perhaps even the mounts on the hydraulics uses to lift/lower the lid.

- For example, the sensors are places 'all over' the top part of the lid so that the landing/tandemizing system and software knows where the craft is touching the lid and also the subsequent touches.
- For example, if the force is 'strong' that can be used to minutely increase the speed of the platform, and thus in addition to the means used to align and make tandem the platform and the craft, the ramp means can be an added means as the craft is very near.

*A ramp assembly and system to grab/tether/attach to the still in-air craft and 'pull' to the platform:*

There can be mechanical means to grab the front wheel/assembly of the craft after the lid has been touched, and where the touch point, force and angle displacement of the lid can give indication of the where the craft is, its momentum, and angles. Thus, the mechanical means (say some type of clamping means mounted in the platform, one for each side the wheel can clamp the wheel and at that point the platform and the lid assembly will lower the craft to the bed.

Another means to consider to be used to bring the craft onto the platform is that the lid can be thought of as a control stick, where once the craft is 'close to the platform' and the craft's touching it can be given greater weight in the control. For example, the craft wheel may 'tap' touch the lid few times until its other legs/wheels are on the platform. Thus, the touch taps can be akin to a human tapping on a game joy stick, etc.

A variation is for the craft to be landing gearless (described more in Fig 8 section) – as the tethering means can attach the craft to the platform (and a benefit being to save weight). Thus, in the event of the craft 'crash-landing' a means of 'air-bag/s' system can be mounted in the internal undersides of the craft body and/or wings where at impact or preferably before impact (determined by the software systems in the craft, or by remote system which is continuously monitoring the craft such as at the craft's operation center) the bag/s will deploy. The shape of such bags can be ski shaped with upturned front area and for the undersides to be of materials to enable a certain amount of sliding over the ground surface. Such bags can be mounted directly to the frames of the underside body or wings, however they can also be mounted on arms* (which are attached to the craft's underside frame or underside of the wings) and where such will come out or be 'released' and 'snap' or lock into place (e.g., if held internally by spring tension) and where its ends and frame is where the bags are mounted. Such arms can also help to absorb the force of any impact and can be made to break away from the main craft body, or to be replaced and thus help protect the main structure of the craft. *One means is similar to how the landing gears on the crafts fold/hinge from the undersides.

Also, experts in AI, driverless vehicles, machine vision, motion detection and balancing (the operating system for Segway and the two wheel scooters, etc.) may prefer to add, modify, change to the protocols, sequences, sensors listed, etc. from the descriptions in the invention.

## Fig 2 – the runway spur with the furrows for the platforms

The wheels of the platform is below the tarmac, and the platform bed can be at the level of the tarmac so that, the craft can roll on to in on its own power. As necessary, the tarmac between the furrows/trenches can be lower to accommodate the platform chassis. Also, there can be mechanical and powered means in the furrows or the tarmac (e.g., at the center area for the platform) to help move, lock in place and to assist the platform to move out of the furrow and onto the regular tarmac.

This system can be used with rails in the tarmac area and rail wheels on the platform.

Prior art 'Aircraft landing system' shows a landing gear-less system; conveyor, and carrying means on rails. https://www.google.com/patents/US3380690

This Fig 2 maybe especially good for fixed wing crafts, including the small 'corporate jets'. The crafts can land and proceed as normal to their docks or gates, or turn-off to the spur to be ferried. The spur can also be placed at the end of the runway.

1- Is the top view of two runways and the spur in one of them with two platforms at rest end to end and ready to receive the crafts. It is possible for a VTOL to directly land on a stationary platform.
    a. '…V/STOL aircraft generally use a runway if it is available. I.e. short takeoff and vertical landing (STOVL) or conventional takeoff and landing (CTOL) operation is preferred to VTOL operation' https://en.wikipedia.org/wiki/V/STOL
2- Is the view of the several platforms (lined up), end to end, in the burrow with its bed level with the tarmac, with a craft on a platform. The craft has come to the platform at the top of the line, and the platform is ready to move. The platform can move on its own to the programmed destination, or be directed by the pilot by a control interface in the cockpit, or by a designated control (e.g., at the airport traffic management central or that of the craft's service provider).
3- Not shown are the mechanical and power systems to assist the platform to move while in the spur area.

*(Not shown) Alternate in-ground (tarmac/runway) platform-elevator*

A ‘platform-elevator’ means in the runway or tarmac that will lower or raise the platform. The platform will move onto that platform-elevator and to be ‘perfectly’ aligned on top of it so as to minimize the edges’ gap between the platform bed and the runway; and the platform-elevator will lower the platform so that the bed of the platform is level with the runway; then a craft rolls onto it and stops; then the platform-elevator will rise and then the platform can move off the platform-elevator. When not in use, the platform-elevator is level with the runway and its top part material (exception being the rods (in the following) which maybe of metal and is flush to the top of the platform-elevator) and its structure is compatible for the crafts to land, roll over it and move about.

A means for aligning the platform ‘perfectly’ on top of the platform-elevator:

There are sensors and/or computer readable means on both the platform and the control system for the platform-elevator (e.g., cameras mounted on the platform-elevator surface to see the bottom of the platform; cameras on the bottom of the platform to see the top of the platform-elevator and/or the rods, etc.).

The platform will move onto the platform-elevator area via a best-effort alignment.

After the best-effort alignment, and if within parameters; there are say 4 rods (mounted on the platform–elevator structure, or via a pass-through to the ground area underneath) that will rise and go into designated receptacles (the female counter parts) in the chassis/frame of the platform; and lift the platform so that now the all or most of the weight of the platform is passed to the rods. This will align the platform so that it can be lowered and fit with the platform-elevator opening. The platform-elevator and the rods will move in snyc to lower the platform.

To raise the platform (and a craft on the platform), the platform-elevator and the rods will rise so that the platform-elevator top is level to the runway, the rods retract and the platform will roll off. If the rods are mounted to the platform-elevator structure, when it is not used for the platform, the rods will lower to be flush to the top of the platform-elevator.

Different sized platform-elevators can be installed to accommodate the different respectively sized platforms and/or differently functional (e.g., some platforms will have beds that tilt) to accommodate the crafts which will be directed onto them.

## Fig 3 – a sequence of V/STOL craft landing on and taking off of the platform on a short-ish runway

In this variation the craft has retractable skids/legs instead of wheels. The normal wheel assembly has been swapped out or replaced with a lighter skid assembly. The dynamics of landing can be different for the skids vs. wheels and require adjustments to the respective software in the craft and the platform.

Also, a special purpose ramp (shown in Fig 1) can be raised a bit for the front skid to land on it or touch it and then to lower after all 3 skids have touched the platform. Skids can save weight of the craft.

1- Top image Is the platform moving ‘down the runway’ and optionally its nose being raised at an angle to assist the lift off; e.g., the front of the craft is raised or not at all – depending on the type of the craft, e.g., if STOL, VTOL, or conventional wing and the speed, wind strength, etc.
2- Lower image Is the craft landing on the bed of the platform, the front touching the lid.

Fig 4 – is a V/STOL airport design

The platforms can move or be stationary, to accommodate the S/VTOL to land, this shows short-ish runways. (The Tesla chassis can accelerate to 60 mph in 60 yards with a total mass of 5,000 lbs.)

1- Is the landing/runway area where the platform waits for the craft. Alternatively, the platforms can be lowered and in the runway as previously described for the spur means.
2- Is the take-off runway. Optionally, take-off and landing can be done on one strip, to save space.
3- Is the platform turning areas.
4- Is the airport dock area, passenger loading, craft maintenance, etc.
5- Is the passenger pod movement area (Fig 5). One lane to load, another to unload.
6- Is the passenger pod. (Tug is not shown)
7- Is the craft on the platform.

Fig 5 – is the passenger pod and the craft at the dock area

1- The passenger pod carry platform (the platform can be smart; have its own mobility; however it is shown with the tug for mobility, smart system, and guidance). The pod can be pushed onto the craft by a tug (4) at the rear, or a rhomba like means that can lift the front area of the pod; or floor based conveying system. There is also battery on the pod to power various systems such as the passenger check-in 'Point of Sale' unit (e.g., payment card reader or scanner), ticketing related, etc. The pods can be for single seats where they can be attached to each other while being conveyed. Also, if single seats, they can even be used to pick up individual passengers at the garage or curb and programmed to take them to the waiting area or craft. Hand rails, safety bars, etc. are attached to the pod platform; also, the payment and check-in means are mounted to the 1, so that they do not have to be loaded to the craft.
2- The bed onto which the seats are mounted – in order to minimize weight.
3- A securing means on the bed to be secured to the craft when the pod-bed is loaded.
4- The tug to push/pull and steer the pod. The tug or 'rhomba' like (also see the Walmart patent in this document; also the Amazon Kiva robots), that is attached to the rear (or even under per the Walmart patent) of the pod to move it, additionally, if it has enough mass and power or means to 'hold on to the floor of the airport', it can even push the pod onto the craft or extend a tether to the rear of the pod to pull it out. Or the tug can even move onto the craft while attached to the pod by extending the 5; and then after the pod is secure, it will detach and move off the craft – in this case, the craft is ideally at level or lightly lower level than that of the floor or ramp.
5- The mechanical means attaching the tug to the pod (1); and mechanical steering means for tug to steer wheels of the pod (e.g. inside the pod are mechanical 'rack' attached to the front wheel axel to which the mechanical steering means is attached and controls).
6- Rear of the craft and door/bay area.
7- The passenger safety cage bars attached to the pod; the POS, checkin means are attached to it.

Additional description:

A steering means (this part maybe additionally inventive) is for the tug or the rhomba/Kiva like robots to turn the pod's wheels and to steer it - by directly attaching itself to an axel that the pod wheels have. (Say that the pod is otherwise motorless.) Where:

a. The pod has wheels with at least one axel (as opposed to be free rolling).
b. The axel additionally has a bar or such to steer the wheels.
c. The tug has attachments (combined or separate) that will fix to the axel and the steering means.

    i. One attachment when rotated (or other means such as reciprocal actions), will transfer that rotational force and direction to the axel, and to the wheel.
    ii. One attachment will cause the steering bar to move to the direction desired.
    iii. Braking can be done by brakes on the tug (and stopping the rotation to the wheels), or by the tug instructing any brakes on the pod to brake.

d. A variation is that the power to move the pod can be done by the tug or rhomba, but where the steering is preferably done by the tug or rhomba (since the pod maybe dumb in terms of its mobility, and to reduce its weight).
    i. If rhomba – the unit will place itself towards the front of the pod, it will raise the pod so that the pod front wheels are off the pavement. The rhomba will steer itself to where the pod ought to go.
    ii. If tug – the unit will attach to the rear of the pod to pull or push it; additional attachments (e.g., from near the front edges of the tug, or a single attachment) will extend from the tug into the rear of the pod chassis where it will hook/mate with gearing/bar to steer the pod's front wheels.

If a goal is to minimize weight and size of the pod system, the pod, the craft and the tug system can be designed – so that the 'only the floor and the mounted to the floor seat assembly' (and the seat assembly is then locked into the craft) is left in the craft, where the above mentioned cage like safety bars, even the above mentioned check-in system is removed with the tug as the tug itself 'retreats'. Thus, they are mounted to the platform and the above mentioned pod is 'sitting' on top of such platform. (If this means is used, then for the event to unload the pod where the tug attaches to the pod to 'pull in back out', if there are cages then passengers arms or similar may be on them, thus the designs will have to take that into consideration, e.g., where the age bars are lower to the floor of the pod.) ON the other hand, the safety bars can be minimalist and light and some can be mounted to the floor of the seat assembly.

### Fig 6 – airport design for fixed wing crafts

Runway can be in a fan/clam/circular shape, so that as the wind direction changes, the assistor-platform or the tug can change the direction of the attack and thus optimize power, reduce noise, etc. The platform and the airport smart AI system will sync with each other for takeoffs, landing and movements on the ground.

The airport system will direct the platform for the optimum direction to go. The airport monitors for wind direction, and such data is given to the management system. This means there will need to be guiding system – such as GPS, in ground or above ground means for the platform to orient itself. There are a host of alternative and technologies that can be utilized for

### Fig 7 – robotic cargo cart (<u>FYI – link</u>)

The robotic cargo cart will have much of the smart, AI, and autonomous capabilities as described for the platform for the crafts, albeit for its particular use cases. The cargo cart is envisioned to be battery/solar powered (btw – Tesla car chassis could be very informative to the platform design, as well as for the AI, etc.; also Tesla car is going some 200 miles on a single charge and thus the carts could stay on the tarmac for a 'shift' or so and then go to the recharging stations). Additionally, the cargo cart's chassis and its operating system can be modified (or swapped out) to ferry other objects – for example, a work/repair bed (i.e., a work-platform) with scissor lift; perhaps a container with fuel for small crafts with pump and all necessary fueling components, or battery to swap and swapping tools; etc.

The cargo carts are to be autonomous in doing their tasks or in combination with human control (on the tarmac or in an airport command center). The control can be direct (i.e., steering) or can be directional such as for the next task or action. Such remote system and interface can be a console, on a tablet, or via headset with voice commands (e.g., to speak commands such as ‘stop’, ‘now, carts 3, 6 and 9 in tethered sequence proceed to Bay 1’.

Notables:

- The cargo cart can be ‘electronically’ tethered – so that, the carts will move as if hitched to each other; however, some carts could come off the line at appropriate locations and the others move to fill the gap and continue. The electronic tethering can employ beacons mounted on the cart, camera readable/recognizable images (thus each cart will have cameras), LIDAR, etc. Thus, depending on the situation, each cart is capable of being the ‘lead cart’ and to have other carts in the procession/line to follow it. A form of swarm intelligence is used.
- At least for the foreseeable future: determining the number of carts to call for and where they must go, even their steering, etc. will be substantially instructed by the human workers, ; workers will also command where the lead cart will stop/pull up to (e.g., to line up to the baggage conveyor), albeit the cart can learn over time per given task instruction (e.g., ‘come to conveyor xyz for the airplane to load baggage’); workers will preferably have a console or tablet to manually steer, drive and otherwise command the carts. Some instructions will be for the lead cart (and the following carts will follow the lead cart), and some will be for all the carts in the group (e.g., emergency stop).
    - Eventually, the manifest of the airplane is known; each baggage or at least the cargo containers will be tagged, and their customs requirement (if any) is known; even the container order of loading and thus unloading can be inferred by their respective tags position and the carts with scissor platform are ready for the containers to be directly loaded to them.
    - The scissor platform will rise to the level of the bay, receive the container, lower, move away to make way for the next cart; and then when done will line up and move to the container off-loading area.
    - Thus, experimentations, history of uses are required to determine the level of autonomy for the carts and their movements by human workers. In the beginning, in fact most of the actions may be directed by the human workers – such as identifying the individual carts to be used in a group, to steering them (e.g., by a console on a tablet, etc.)

*Figure 7*

1- Is a side view of the cargo cart.
2- Cart chassis: Battery; markings for LIDAR/cameras (e.g., to be used for computer vision); intelligent systems (i.e., the AI, software); chassis; sensors; and the optional mechanical designs to allow the ‘bed assembly’ of the cart to be removed from the chassis and to be ‘swapped’ for another use; audible speakers/bells/horns to indicate in-motion, warning or sound to human workers; mounted of each cart is at least one of a manual interface for human workers to either override (emergency stop) or steer the cart/s. Each cart is uniquely identified.

3- The cargo cage.

4- Optional mechanical (i.e., physical) tethering and steering means.

5- Shows 2 carts ‘hitched’ electronically; one being ‘led’ or following or guided by the lead cart; the communication/sensing means between them as well as each with (7) their surroundings.

6- Is an interface for a human operator to control the cart and the current uses on the cart.

10- Shows the scissor cargo cart with a container capability – where the cart rises for the container to load and then – either automatically or based on commands by the worker, lowers and moves out of the way for the next cart, or can immediately go to the container warehouse; or if the cargo cart is street-road rated, it can even self-drive to ‘deliver the container’ to an address.

11- Scissor assembly optionally which can be swapped out with the cargo cage assembly or others.

12- Top of the scissor assembly with surface with rollers (13) is desired.

13- Is the cart with container ready to be loaded onto a plane (not shown).

*Some current arts for the Fig 7 robotic cargo cart:*

Walmart’s. SHOPPING FACILITY ASSISTANCE SYSTEMS, DEVICES AND METHOD

‘…The patent details how the facility assistance systems could be implemented. The shopping carts would work with detachable motors, which would be equipped with multiple sensors and video cameras, and be controlled by a facility circuit system…If a customer wanted a cart, for example, they could summon one through an app or an in-store kiosk. The nearest motor would then find the closest available cart, dock with it, and drive it to the customer’s location. At that point, the motor would detach and drive itself to a holding area for the next request’ www.digitaltrends.com

‘…It works, essentially, by putting a Roomba-like robot under the cart, which then drives it about as directed by the shopper… The entire system is, in turn, placed in a sensor-rich world, where central computers track inventory and match customer needs to what’s available in the store for the shopper. It is as though every search function when buying something online at, say, Amazon, is instead done in real time by robots and computers while the customer is at the store.’ http://www.popsci.com/

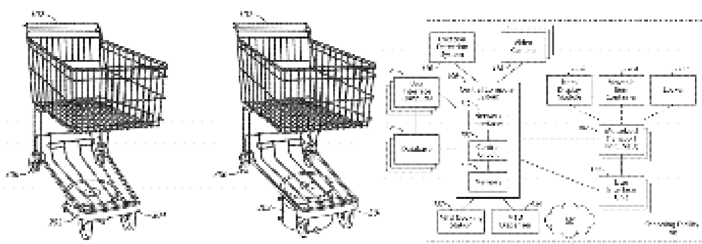


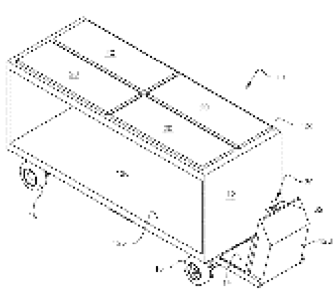
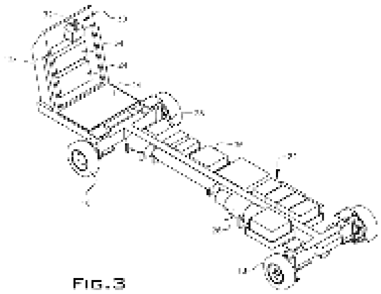
FIG. 3A FIG. 3B

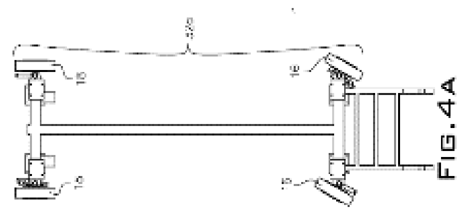
Robot Valet To Park Cars At German Airport

‘…the robot, nicknamed Ray, starts work Tuesday and can be booked using a smartphone app… all travelers need to do is leave their car in a designated area and confirm it's empty and ready to go…Then Ray or one of its cybernetic colleagues will take the car to one of 249 parking spaces reserved for robots... http://www.usnews.com

US 8141666. Solar powered airport baggage car

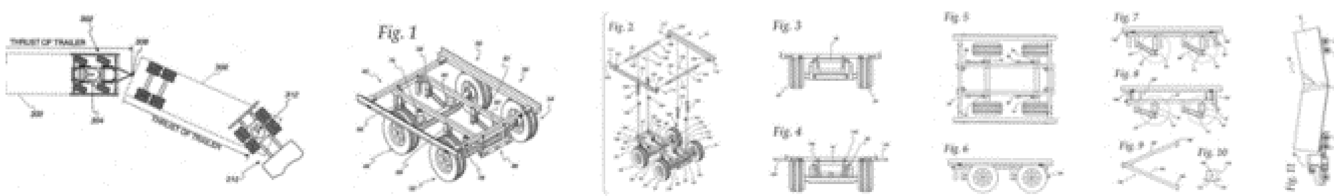
https://www.google.ch/patents/US8141666




US 20090250901. Converter dolly for a tandem trailer

https://www.google.ch/patents/US20090250901

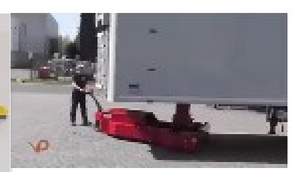



('End of robotic cargo cart section' and next part is back to the crafts and its platform)

Various other use-applications for the platform, e.g. conveyor, trailer, moving pallets, etc.

The following are images of equipment at the airport. The platform can be modified - e.g., base enlarged, putting more mass in one to offset extension at the other end, e.g., the below image for mobile passenger stairs - for equipment such as: passenger transfer vehicle; mobile passenger stairs; baggage conveyor.





## About the 'Three zones' of control...

where the craft is autonomous to where the platform and the airport takes control over the craft:

The three are: where the craft has control; where the craft and the stations/airport areas of control overlap, and transitions; and where the station/airport has the control.

For example, from the landing approach, to touch down, while on the ground and until the craft has taken off and cleared the airport's control perimeter/zone – the local system has control of the craft's movements (albeit, at the taxing to and the take off the craft will start to exert its own controls related to the take off and the platform speed, direction and other assists activities will need to be synchronized to the airport system).

On the other hand, the craft may be given control to the platform, i.e., the craft will control the orientation, the speed, the tilt of the bed. After landing, the platform will take over control. And then, when the airport has given permission to being the taxiing for the takeoff, the craft will take over control over the platform, and its speed, direction, and tilting of the bed.

At the overlapping zones, there can be a blend of control based on rules. Also, there can be a period of time where the airport system and the vehicle system will exchange information, and for the airport system to also be connected to the vehicle's control decision system (the AI, the LIDAR, radar, etc.) so that the airport can both 'see' from the craft as well as from sensors mounted at its own dock-station and vice versa for the craft.

## A representative sequence of events for a craft using the platform and the airport

- The craft approaches the airspace of the airport and begins to talk to the airport for landing related information and its time of arrival, etc.; all data and information communication is done over a secure channel and/or encrypted
- The airport gives to the craft:
    - the designated platform identification, the platform's control authorization codes and/or protocols,
    - other processes (e.g., airport giving the craft's info and security codes to the platform),
    - other landing related information and data to the craft; the
- The craft and the platform talk and authenticate with each other; craft takes over the movement controls of the platform, its speed, etc.
- The crafts lands on the platform, which can be stationary for VTOL; but if desired the platform can be moving and 'mirroring' the landing speed and angle of the craft. Alternatively, the landing can be done on the tarmac.
    - If landing is on the tarmac, then the platform and/or the craft can move toward each other, and the craft to be loaded onto the platform.
    - While on the platform and during its movement to the dock, some maintenance could happen for the craft, e.g., recharging.
- The platform takes control over the movement and moves with the craft to its instructed area such as the passenger embark area/dock.
- Passenger pods are unloaded and new pods are loaded.
- Airport and/or the craft's operation center gives permission or command – to the platform and/or craft - for the craft to take off, the runway identification (if several).
- The platform moves to the top of the taxing area and the platform and craft optionally waits for a 'take off' command or instruction from the airport.
- The 'take off' command is received by the craft and platform, and the craft takes over the platform movements – i.e., the direction, the acceleration and raising of the nose (if desired).
- The craft and the platform accelerates and the craft becomes airborne and relinquishes the control over the platform.
- The platform moves autonomously or in conjunction with or under the control of the airport communication, command and control to the queue of other platforms for the incoming crafts.

Fig 10. A more detailed sequence for a craft using the platform and the airport

1 Craft approaches the airport area (jurisdiction).

2 Craft and airport communicates and exchange information*: where the craft is, intention, status of each other; at least some information is also transmitted by each to their respective central operation center – as check procedure failsafe procedure, each may repeat the information received from each other (as well as certain information from other crafts (if any) in the airport area, including of crafts of other service providers) to their operation centers. Some information and communication can be done while the craft in still on the flight and approaching the airport area or the craft has entered the airport area and has stopped.

Additionally and optionally, at each appropriate waypoint the craft can communicate to the airport and to its central operation center – its various information and data, status (passengers to load or offload, ETA, etc.)

*Information exchange/processed include:

- By Craft: Passengers to get off or received request to board; if craft is on-time or not; its preferred departure time from the airport; if craft wants to wait at the airport until some future event or instruction from airport or its central operation.
- By Airport: If other crafts are in the airport and in the airspaces 'near' the airport; their position/momentum, intentions, etc.; if passengers have requested to the airport to board the subject craft.
- Each may also wait for instructions from respective operation centers – e.g., the airport* may have instructions that may override both its and that of the crafts (e.g., report of an accident in the road up ahead and for all crafts to remain at the airport). *The airport is generally assumed to house its operation center, however and depending on the level of automation, there can be a greater regional operation center for the airport and that some of the command, control and communication system for the airport will be controlled by the regional operation center.
- Rules are obeyed by the craft and airport based on the protocols set and agreed to by respective systems (crafts (where one service provider may have priority over another, etc.), their service providers, the airport, their respective operation centers); and these govern for each decision points while in the airport. Exceptions are that some 'master' control can be given and made available for ground crews (the human station master) to override any system, instructions or control by the respective systems.

3 Craft communicates intent to, such as: to load/unload passengers at the airport; to recharge/swap batteries; or to land and wait at the airport; etc.

4 Craft and airport runs (if not already done) procedures, sub-routines to see if other event or crafts are at asking to land, etc. Additionally, they discuss the weather and wind conditions at the approach and landing – e.g., if conditions are within the parameters to land on the platform or if 'too windy' then to cancel the platform and to land directly on the tarmac; etc.

5 Decision is made to land on the platform.

6 Airport gives landing protocols and instructions; any event/instructions overriding the landing? Yes/No/Wait for further instructions/Are there other crafts present and are they occupying the approach space, etc.

7a If Yes to landing: Airport gives landing protocols and instructions; the identification of the platform; the platform’s status; and if not already stored in the craft’s memory, the platform operation information, access to platform command and control protocols; the platform moves to area (if not there already) to prepare to be instructed by the craft; the craft takes over the control over the platform and its movement controls.

7b If No to landing, some instructions or routines can be: Craft is instructed to delay landing; go into a holding pattern; etc.

8 The craft instructs the platform to move/accelerate to be in tandem with the landing speed and momentum of the craft; all the while an ‘abort the platform’ routine is running to see if the craft ought to land directly on the tarmac and instruct platform to move out of way, etc.

9 Craft lands on the platform* or the raised bed (if such bed is provided, and the bed is lowered); the craft instructs the platform and airport that it has landed well; and the craft’s engines shut down. *There can be flaps or other means in the platform which can rise up to help arrest the front wheel from forward motion after the craft has landed.

10 The airport or the platform takes control over the platform and move the platform to the designated docking area.

11 The passengers/pods are loaded/boarded. Meanwhile, routines are running for next actions of the craft or the airport (last minute passenger request), if to delay taxiing, etc.

12 If to depart, the platform moves to the runway area; the craft take over the control over the platform and instructs its acceleration speed; raising of the nose (if desired); for the active noise cancelling system to turn on; etc.

13 The craft may make its own minute adjustments to the propulsion system, its flaps, and begins to lift off the platform.

| |
|---|
| 14 Craft takes flight, leaves the airport area, enters the general airspace and operates autonomously and in communication with its operation center, and either can communicate its ETA and current (pending status, intent) to the next station. |

| |
|---|
| 15 ‘All’ events, ‘performance’, movement data of the craft, other crafts, passengers load/unload, time of arrival/departure, any aberrations, nears misses, performance range within/out-of the constraints/safety-parameters for each routine, weather conditions, traffic, conditions of airport (potholes – using motion sensors on the platform), etc. are stored, scored, flagged by respective systems. |

## Additional Invention Descriptions related to the Platform, Crafts and Airport

### Variation – as a Tug or Low height truck

Instead of a platform, a limited version of the invention is for a tug or a low height truck to move the craft around on the tarmac. It can hook onto the craft’s front wheel assembly. It can even assist in the take off by moving down the tarmac and help the craft to build up speed. If the craft’s front wheel is resting on the tug or an extension thereof, the front wheel and the nose of the craft can be raised at near take off speed if such will assist in the takeoff. The tug can be in front of or behind and under the craft. (Note: This tug-part of the invention is covered in part/perhaps substantially by the prior art ---- US 2013/0333971, a towbarless robotic airplane tug.)

### More description on the Platform for VTOL crafts…

where they are using modified version of the systems and protocols described previously:

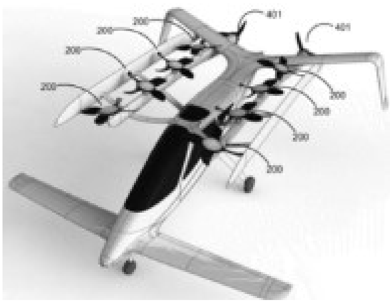
- VTOL crafts land on the platform
    - The platform is stationary at a designated landing area for the VTOL craft.
    - If designed, and as an option, the bed of the platform can be made to tilt a little or rise up using hydraulics if desired, to better mate with the angle of the VTOL and to soften its touch down.
    - The weight of the craft be stored in springs and hydraulics and to release at controlled rate to move the platform or the bed up for the takeoff.
- The platform moves to the docking area where passengers or cargo can off load.
- Maintenance
    - While in transit – the platform’s maintenance and craft-system check services can connect to the craft via robotic arms, etc. These can do designated activities such as garbage removal; data transfer; craft system check, fuel loading or battery swapping/recharging;
    - At the dock while loading/offloading – the platform itself can connect at the dock/port for waste removal, fuel loading, recharging.
- Platform top side (landing area) can be above the platform’s wheels and flat – to offer a larger surface for landing.
- Platform can run on rails – or at least part of the way. Thus, if such the platform will have its own wheels for moving on the ground and means for moving on/off the rails and moving on the

rails. If the airport is dedicated to VTOL crafts, and since VTOLs are vertical, it may be more efficient to have the platforms to be guided on rails.

## Continued: More description on the Platform for V/STOL crafts

The platform can be sync'd and in motion to enable the crafts to land or take off and thereby reduce power needs and reduce noise. It will move down the runway to assist in the takeoff. Additionally, the platform/bed can tilt to allow the crafts to touch down at an angle, and then the platform can come back to horizontal. And in the reverse for the takeoff.

Example of a V/STOL craft:



Zee.Aero pat. Pending concept for VTOL craft.

Thus, the platform can 'assist' in crafts to be more short takeoff and landing capable. Platforms can be designed specifically for particular craft's takeoff and landing characteristics. For example, the surface of the platform can have contours to 'work better' with the downdrafts of the particular craft's propulsion system. Also, the platform designs could be different for V/STOLs vs. the fixed wing crafts. Trial and error study and wind tunnel experiments can be done.

## Platform can be stationary or 'mounted' to the runway, or even home driveway

A personal V/STOL craft could 'land' on the platform mounted or placed on driveway of the house. There are multiple ways for the platform to be placed. The platform can move back and forth on the ground or be on rails or be stationary and mounted/attached to the driveway or the ground; perhaps even the 'rooftop' of the home could have such landing platform. The platform or bed can rotate – if the wind direction changes.

A feature of this platform is that the bed (or the contact part of the platform to the craft body or the craft wheels) of the platform can tilt or angle itself to help 'mate' to the angle of the craft when it is landing, and also the bed can rise up a bit as well to 'help absorb' the landing forces. A benefit is that the pilot or the craft can be off a bit but still make a '3 point touch' (the 3 wheels to the bed/platform) landing and additionally, have the landing forces to be absorbed.

## Other - Communication and information system linking the airport to passengers

To have the airport system to feed information to the passengers in the crafts - there can be retractable monitors mounted on the platform, or instead such information is directly feed to and displayed on displays in the craft and to smartphone applications. This information and communication includes: local news and connecting ground or air transportation; voice announcements to the craft's communication system or to the smartphone application; and can be even two-way capable via speakers and microphones in the craft to enable live conversation or queries between the airport or the craft's service provider with the passengers.

## Other - Sound reduction for the airplane/craft/VTOL

A description of some of the top current approaches follows.

One is physical – in the shape and design and materials, for example for the shape of the nacelle, “noise control tubes”, or sound absorbent material. The other is noise cancelling/acoustic - “…active noise control (ANC) is applied using destructive acoustic attenuation…the use of active noise cancellation techniques to cancel sound radiated from airplane engines’’ (US 5732547). US 5222148 describes “Active noise control system for attenuating engine generated noise”; “noise canceling waves are generated by a noise canceling actuator in response to the filter output signal, and the canceling waves are superimposed with the undesirable noise generated by the engine.”

In these current art the systems are mounted on the craft, and thus some more effective alternatives are not tried due to the ‘prohibitive’ size, weight, and other considerations. Also, there are the ground based or mounted systems, such as the sound barriers/buffers near the runways.

The invention is that these systems are mounted on the platform or in conjunction with the ground based systems.

Various systems for noise barriers or absorbent, as well as active noise control system using sound waves can be mounted on the platform or even the tug. Thus the noise cancelling/control system is “placed as close to the source” as possible without actually being mounted on the craft.

There can be a variety of combinations and strategies:

- Honeycombed surface, especially where the wheels of the craft is not expected to come into contact or where wheel channels (guides) are mounted on top of the honeycombed surface. The honeycombed surface will redirect the noise instead of reflecting it. The honeycomb design can additionally be attached at their “bottom ends” to tubes, if to assist in channeling the sound.
- Sound absorbent materials can be mounted on surface areas of the platform.
- Active noise control systems can be mounted on the platform or the tug. Microphones to pick up the noise sources are used. The can be placed on the platform or the tug, and optionally along the travel path as well as near passenger areas and areas that border offices and residences.

Thus, the invention includes the noise cancelling or sound reduction apparatus, methods and systems where such are mounted on the platform. There will be a network of microphones or noise and even perhaps vibration sensors.

## Other - Capsules or Pods for passengers and/or cargo, means to load and unload from crafts

The above mentioned pilotless crafts (Sky Taxis) for ferrying passengers for ‘short hops’ are expected to be small (2 passengers, to say 4) and the flight cadence to be as rapid as 10 seconds. (Dr. Brien Seeley, CAFE Foundation, ‘Regional Sky Transit’). Thus, passengers can pre-board onto capsules or pods prior to ‘flight time’ (settle in, relax, buckle up, etc.) and the capsules will then be conveyed, moved or attached to crafts. And to disembark, the reverse and the passengers can ‘more leisurely’ move out of the pods.

Also, the pods can be topless or without the canopy – thus, while waiting they may feel more comfortable. Also, then the capsules can be interchangeable among various craft manufacturers and designs. Then the pods will be placed into the craft, secured and the canopy to lock and seal.

Also, pod can be ‘resting’ on a platform itself where the platform* is the main machine for moving the pod, and the passengers’ seats and carry on compartment are mounted to the floor of the pod, so that this section can separate from the platform at the pod loading area; then there are means for the pod-capsule to be lifted/detached from the platform and for the pod to be moved into the craft. For example, the pod capsule frame can have small wheels and for the platform to push the pod into the craft; or onto a conveyor-belt, etc. Or that the platform may be at a raised incline (or bit higher than the floor of the craft) so that the pod can be more easily rolled onto the craft. There are many ways to work this out mechanically. (This is described in another section of this document as ‘rhomba’ robot like.)

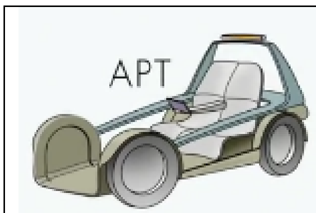
Also, the loading can be top loading by picking up the pod and placing into the craft; side loading – by a conveyor and/or self-moving platform*.

A challenge with this pods system is that the passenger area of the craft may need to be volumetrically larger than if the passengers load themselves directly into the craft. It will need to be larger to have larger openings for the doors (e.g. if sliding) and to receive the pod.

*The passenger pods can be on a self-powered platform where the platform will move on its own power into the craft. The pods-platform can be guided by a variety of schemes – these include, sensors in the floor, walls and ceilings; LIDAR; guides on the floor; etc.

The Zee.Aero concept craft (image previously) shows that a rear entry (and extraction) for the passenger pods could be achievable as the wings and the propulsion systems seems to allow for a generally minimally unobstructed rear area.

*FYI: a current art*

| | |
|---|---|
|  | Airport personal transport.<br>‘…a (autonomous) driverless car that will take you seamlessly from carpark to boarding gate…The semi-autonomous, electric-powered two-passenger vehicle will travel at three times walking speed to take passengers to their destination… This prototype will demonstrate that automated, small, electric vehicles can safely carry two people and their bags within airports among pedestrians and other vehicles.’ Daily News 2015. |

*A representative sequence for the pod, its design, its robot tug or ‘rhomba’*

1. Instead of going to a waiting area, the passengers go to where the pods are, pick the ones that are for their flights and settle in. The pods can replace the ‘waiting area’. They are parked or grouped per destination, time of flight or the craft service provider. The passengers are directed to board a particular pod and to wait.

2. Pods movement:

- The pods in this area can be on rails or a conveyor system or on a robotic wheeled platform. And at near the flight time, the pod will move/be moved toward the craft area (which may or may not be there yet).

- One of the preferable method is a rhomba like robot (not unlike the Walmart patent – where it goes under the shopping cart and raises it's front and brings the cart to the shopper) that will go under the pod, raise the pod of the floor and both move and steer it; the rhomba can carry the pod into the craft itself and then disengage and back out under the pod (if rear entry as in the Fig.).

- Another preferred method is a robot tug attached to the rear of the pod and means to steer the pod. With this means, the tug is not under the pod and thus after pushing the pod onto the craft, it can more easier disengage and back out of the craft.

3. The pod load/unload: The craft will arrive (e.g., on the craft-platform) to the docking area; its door 'bay' will open (e.g., at the rear of the craft); the pod with passengers on them will be made to move off and taken to un-boarding area.

4. To load passengers to the craft: The pod will be moved from the waiting area and loaded on to the craft and secured. The craft's canopy (If open), doors, etc. will secure and ready for flight.

5. The craft prepares to taxi: The platform will move away from the docking area, and down the runway. The hand off of the control over the craft from the airport to the craft begins, etc. The craft's propulsion systems turns on (e.g., after instructions from the airport that the craft is away from the dock area, etc.); and the platform's active noise cancellation system, if any, is turned on, etc.

6. Craft takes flight: The craft-platform will build up speed and optionally raise the nose of the craft; the craft takes flight.

7. The platform moves to the area for the landing crafts.

8. If a crafts lands on the tarmac and is guided to the waiting platform, and the sequence to load the craft onto the platform begins. A variety of means can be used to load/unload the pod onto the craft:

- For example, the ramp box in Fig 1 has a ramp that can be lowered to the runway, grabbing means for the craft's front wheel and to pull the craft onto the platform.

- Another means is for the platform to be designed to have the bed of the platform to be as low as possible to the ground so that the craft can roll onto it. E.g., the platform will not have axel for the wheels and instead the wheels are motorized. The bed of the platform can be lowered and raised (the craft on it) via hydraulic means mounted on the platform chassis.

- In another part of this document is described a 'spur' means; and another, a platform-elevator means.

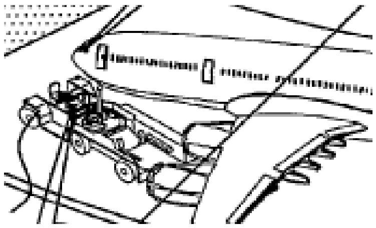
9. The platform moves to the dock.

10. The passenger compartment/pod will be made to move off the craft and onto the ferrying means.

11. The ferrying means will be made to move to passenger disembarking area, etc.

## Some Current Arts related to the platform, craft, airport (PTO search: 'ABST/airplane AND ABST/landing')

US 2013/0333971 – towbarless airplane tug…'robotic tugs for taxiing airplanes…'

- '…The present invention relates to novel robotic tugs for taxiing airplanes from a gate to a take-off runway without using the aircraft jet engines… '
- 

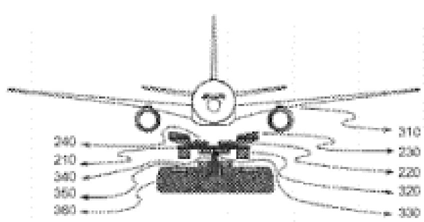
US 9,156,564:

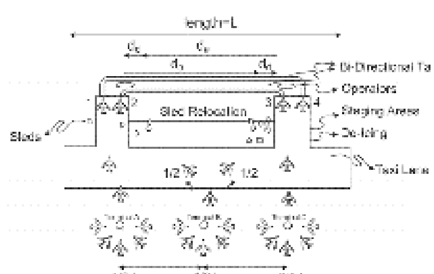
Systems and methods for ground-based aircraft thrust systems are provided. In particular, some embodiments use an electromechanical thrust assembly to accelerate aircraft using ground-based energy for takeoff. The assembly can include one or more sleds, one or more maglev tracks, and/or one or more linear motors. Airplanes are loaded onto a sled…

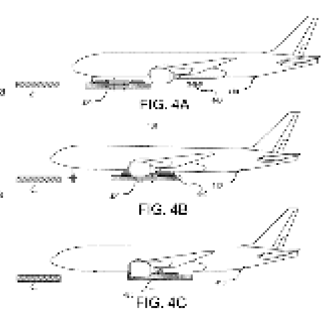
- http://www.exhaustless.com/benefits.html
- 'The main health benefits of using the Exhaustless Takeoff System as compared to a traditional runway are reduced exposure to pollution and noise for communities, passengers, and those who work in aviation.
- 'Accelerating aircraft using grid power allows aviation to shift designs to more streamlined and lighter aircraft. Our higher speed takeoff allows aircraft to operate under conditions where their engines are more efficient, requiring less jet fuel and time to reach cruise altitude.

https://www.google.com/patents/US20140203136

https://www.google.com/patents/US9079671

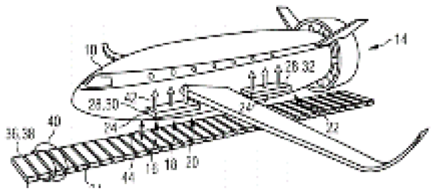






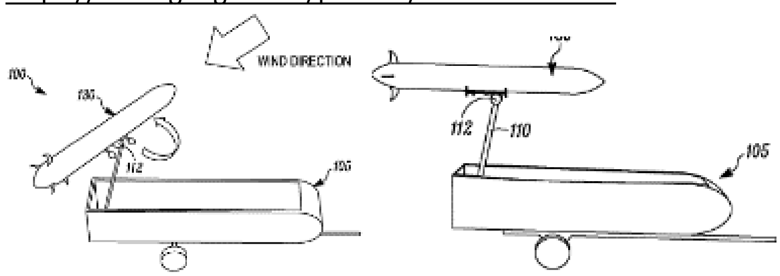

(Airbus) US 20150251561

Air Vehicle and Levitation System for Air Vehicle. 'Magnetically active elements…are incorporated respectively in an air vehicle and in a guide path…Thus, the air vehicle may omit mechanical landing gear.

- ‘It has also become known from the German Patent Publication DE 41 02 271 C2, to omit a permanent landing gear from an aircraft, and instead to provide a sled or carriage that remains on a guide track on the ground, for example on a take-off and landing runway of an airport. The aircraft is supported on the ground-based carriage during taxiing and take-off, and for landing the aircraft must again land precisely onto the carriage as the carriage moves along the guide track on the ground.. https://www.google.com/patents/US20150251561
- 

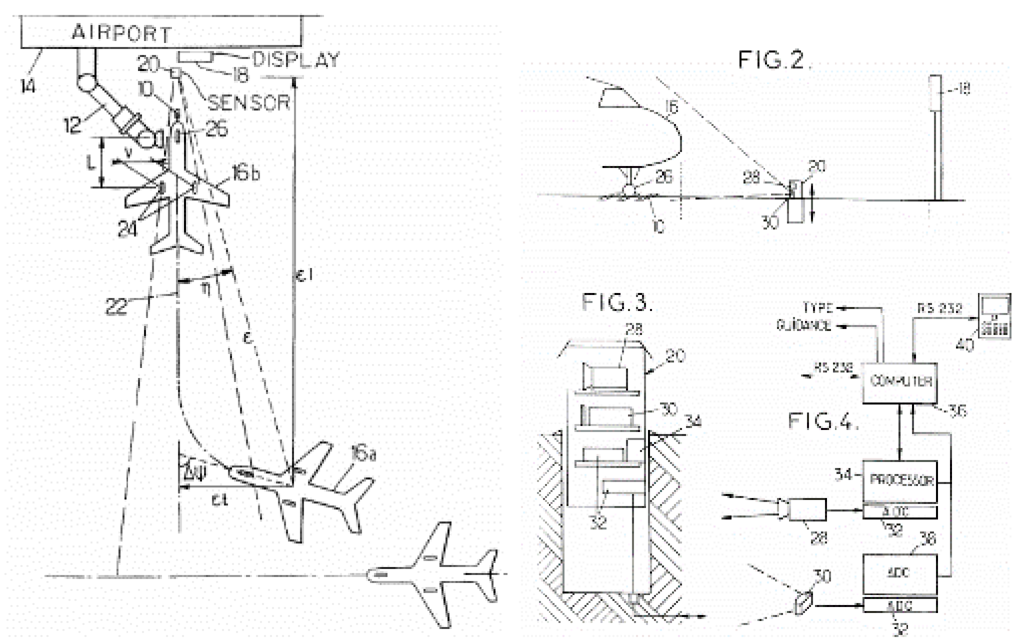
(Boeing) US 20140117153.

Systems and methods to launch aircraft. ‘Aircraft, particularly smaller autonomous and semi-autonomous aircraft such as surveillance drones, blimps, and quad rotors, may be launched from ground-based launch platforms. Weather conditions and wind may complicate launch operations for such aircraft.’

- https://www.google.com/patents/US20140117153
- 

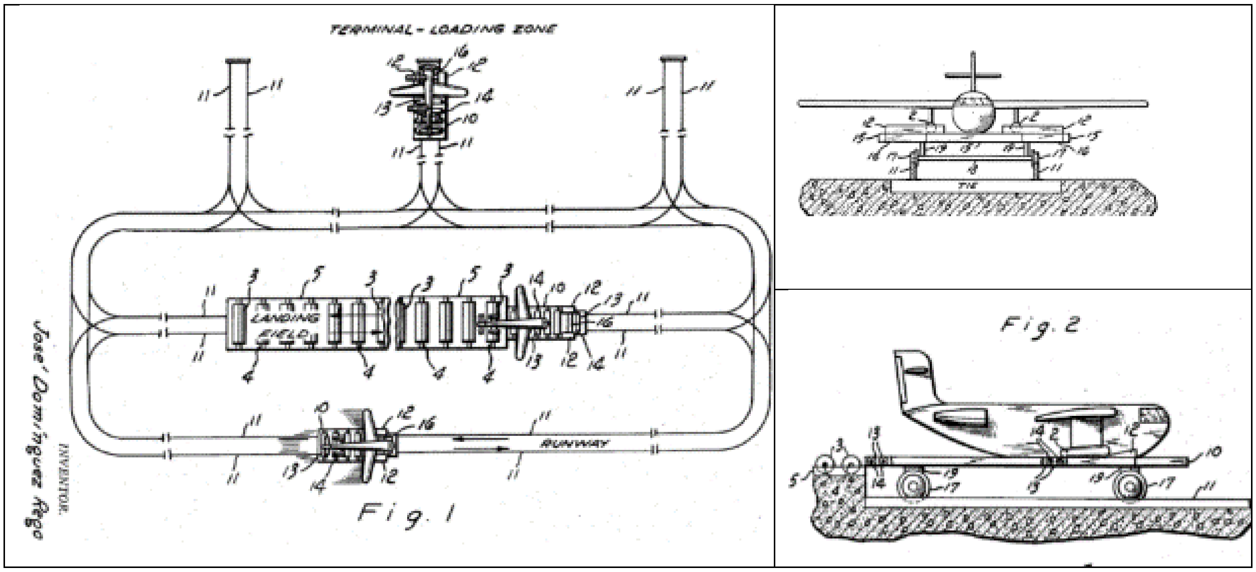

US 6,100,964 ‘Method and a system for guiding an aircraft to a docking station…

‘…a two-dimensional thermal IR image of a station approach zone is formed from a determined point close to said docking station

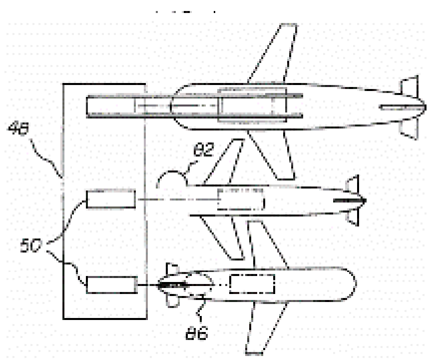
- 

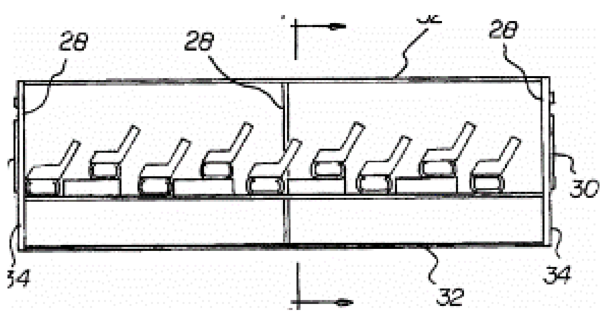
US 3,380,690 Aircraft Landing System.

‘The elimination of several tons of landing gear, therefore, will result in a substantial increase in the payload capacity and/or in the fuel carrying capacity… During the landing operation, the rail car is positioned at the far end of the landing field with its rollers parallel to and in the same plane as the rollers of the landing field…



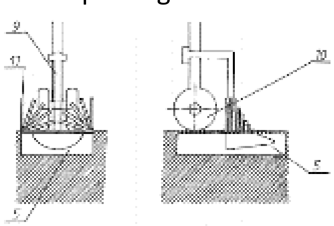

Passenger container/pod US 6,494,404. (In reference to the invention’s pod teachings.)

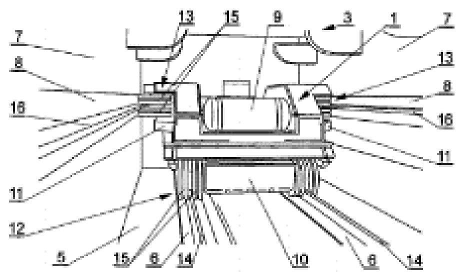


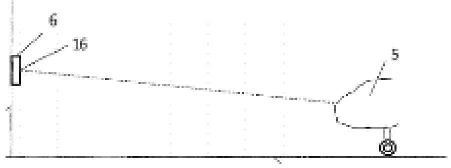


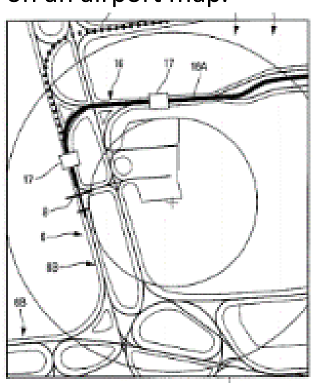
## Some FYIs/other Current Arts related to the platform, craft, airport

Several arts for using the front wheel and carriage, and the carriage moving via an in the ground conveying and guiding system.

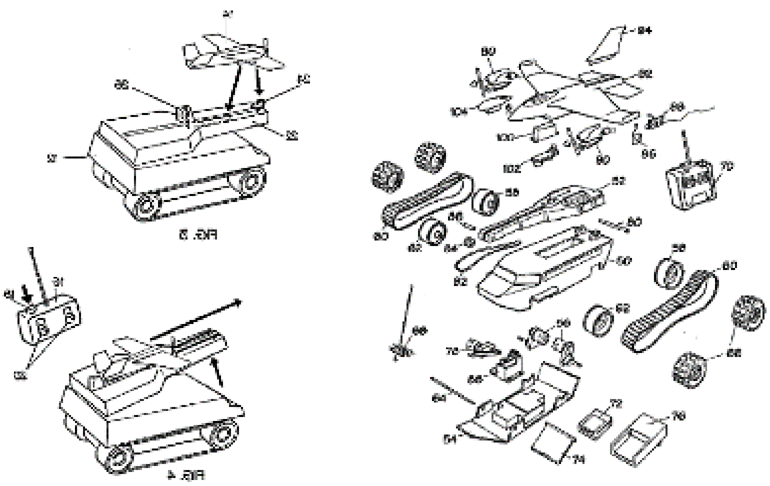
- ‘US 8,757,539. The invention solves the question of a system for transporting airplanes about airport apron from the parking location to the takeoff runway and from the landing location to the parking location with engines switched off.
    - 

- ‘US 6,100,964. Method and a system for guiding an aircraft to a docking station. ‘For guiding an airplane to a docking station in an airport, a two-dimensional thermal IR image of a station approach zone is formed from a determined point close to said docking station….’
- ‘US 2012/0298797 – …transporting airplane from a parking location to a takeoff location – ‘…this concept will result in decrease in the fuel consumption, decrease in the amount of combustion gases, as well as in reduction of noise in the airport surroundings. It is also envisaged to allow diminishing of the amount of fuel carried by an airplane. Thanks to this solution the airplane will be lighter and more economical in operation. (especially, the shorter the flight, the greater the benefit of on-ground assistance for take-offs, taxing, docking…
    - ‘…enourmous quantities of fuel…’
    - ‘…very important…noise reduction…’
    - ‘…traffic safety…’
- ‘US 2014/0318409 – carriage assembly for an airplane transporting system on an airport apron
    - 

- ‘US 2010/0324807 – airport taxiway navigation system…elated to taxiing signs’ etc.
- ‘US 2013/0289866 – for identifying an airplane in connection with parking of the airplane at a stand… (Inventor note: As the pilots can make visual mistakes.)
    - 

- ‘US 2007/0229598 – assisting in the navigation of an airplane on the ground at an airport
- ‘US 8,296,060 - A method and device for assisting in the navigation of an airplane on the ground at an airport employs a display unit for automatically presenting data relating to the path to be followed by the airplane at the airport in textual form on a display screen, and a display unit for automatically presenting this data in graphic form on a display screen, using a plot illustrating said path on an airport map.
    - 

Fyi, fun arts:

- Tractor beams: 'Nasa is working on a Star Trek-style TRACTOR BEAM: System could capture objects in space using light' Sept 2, 2016
    - (Albeit, no mention of tractor beams to assist in launching - but it could be useful as insides of a space port can be very complex, and it would be safer for the space port to control the crafts or confine their movements while in/near the port.)
- Airbus double deck patent: US 2015/0166166 https://www.google.ch/patents/US20150166166;
- '**Toy** airplane launching vehicle US 2004/0116044
    - 

## Other – Variation of the invention for driverless buses, vehicles for hire

### Title: Methods and system for autonomous driverless public vehicles at stations, bus stops

The following is additional information to this topic which was first introduced previously.

Additionally, the invention teaches uses and adaption for ground transportation, in particular driverless, at their stations or stops to load or offload people or packages; as well as at maintenance facilities or passenger hubs. For example, where the 'bus stop' takes over the control (from the bus itself) over the bus/s when at the bus stop.

This invention envisions when driverless vehicles for hire – both small and large capacity (i.e., vans or buses) will ferry passengers on streets and to describe a system

The invention thesis is that when such as vehicle enters or approaches a dock or a port (i.e., where the passengers or the packages would board or get off or be off loaded), there can be advantages if the said dock or port could 'take over the control' of the vehicle's movement or certain portions, or power to override the vehicle's control. These include that the local system would be much more aware and 'in tune' with the local environment and activities there.

The invention envisions use of docks, 'bus station' – where more than one vehicle service provider will use it. Thus, it is possible that at a station, Uber, Lyft, Google, Tesla vehicles will be parked or come in and out, thus the local station will have easier access to the information and awareness of all the activities in its jurisdiction than the individual vehicle services.

The control can mean both (or in combination) of where the station would actively take over the movement controls (the steering, acceleration, stop) of the vehicle, or to only act as a ‘traffic cop’ to signal and to instruct each vehicle as to how it ought to be move and position itself in the station area and in relation to other vehicles (if any).

The vehicles and the stations have to identify each other, see where they are spatially in relation to each other, to other vehicles near or at the stations. For example and respectively their: unique identifications; LIDAR, radar and cameras, their respective software; transponders; beacons, sensors; camera visible signs or in the ground (if station) or markings (e.g., on the vehicles) to aid the other system to “see” and to calculate its the distance, speed and direction; etc.

The phases:

1. Vehicle approaches a zone. Either the vehicle or the zone may instruct the ‘need’ to stop. (E.g., a passenger on the vehicle has signaled desire to get off or a passenger at the spot has indicated desire to get on.)
2. Then, upon entering a certain spot or area (i.e., the ‘jurisdiction of the station’), the station/dock’s system will ask to take over the vehicle’s movement control.
    a. Such control includes: directing the vehicle’s movement (speed, angle of approach, the spot where to stop); its place in a queue if there are other vehicles at the station.
    b. There can be a period of time or a border area where the station system and the vehicle system will both may share control over the vehicle with rules for one to be superior to the other.
        i. It is possible that, the station yield and allow the vehicle to continue its control while within the station’s zone. For example, during off peak hours and when there are no other vehicles in the station area.
    c. Also, instead of the station having absolute control over the vehicle’s movement system, the station can direct or instruct the vehicle to move under its own power from point to point by giving the range of speed allowed and direction of movement.
    d. The station and the vehicle exchange information, and for the station system to also be connected to the vehicle’s control decision system (the AI, the LIDAR, cameras, etc.) so that the station can both ‘see’ from the vehicle as well as at its own station.
3. The station system will bring the vehicle to a stop and either the station system or the vehicle system will run the routine for the disembarking or embarking of passengers or package.
4. Once the routine for the disembarking or embarking is done, the vehicle is ready to begin moving. The station system will first instruct the vehicle to move and its pace and direction.
5. At the edge of the ‘leave’ zone, the vehicle will start to take over the control and once it leaves the station zone, the vehicle is entirely on its own.

Fig 11 - Methods and system for autonomous driverless public vehicles at stations, bus stops

1 Vehicle approaches the station area (jurisdiction).

2 Vehicle and station communicates and exchange information: where the vehicle is, intention, status of each other; at least some information is also transmitted by each to their respective central operation center – as check procedure failsafe procedure, each may repeat the information received from each other (as well as certain information from other vehicles (if any) in the station area, including of vehicles of other service providers) to their operation centers. Some information and communication can be done while the vehicle in still on the road and approaching the station area or the vehicle has entered the station area and has stopped.

Information exchange/processed include:

- By Vehicle: Passengers to get off or received request to board; if vehicle is on-time or not; vehicle wants to wait at the station until some future event or instruction from station or its central operation.
- By Station: If other vehicles are in the station, their position/momentum, intentions, etc.; if passengers have requested to the station to board the vehicle.
- Each may also wait for instructions from respective operation centers – e.g., the station may have instructions that may override both its and that of the vehicles (e.g., report of an accident in the road up ahead and for all vehicles to remain at the station).
- Rules are obeyed by each based on the protocols set and agreed to by respective systems (vehicles (where one service provider may have priority over another, etc.), their service providers, the station, their respective operation centers); and these govern for each decision points while in the station.

3 Vehicle communicates intent to load passengers.

4 Vehicle and station runs (if not already done) procedures, sub-routines to see if other event or vehicles are at the station, etc.

5 Vehicle communicates intent/desire to load passengers at the station.

6 Station: Any event/instructions overriding the loading of passengers? Yes/No/Wait for further instructions/Are there other vehicles present and are they occupying the loading zone/ etc.

7a If Yes: Vehicle receives instructions to load passengers – and either the vehicle or the station operates the movement controls and systems of the vehicle; and to load the passengers.

8 Passengers are loaded/boarded. Meanwhile, routines are running for next actions of the vehicle or the station (last minute passenger request), etc.

7b If No, some instructions or routines can be: Vehicle is instructed to move to a wait area, or to remain where it is;

Also could be to 'wait' and remain at the current spot; and station moves/instructs other vehicles (to) move 'out of the way'.

9 Passengers are loaded/boarded; vehicle and station each runs systems to move away from the loading area and to proceed out of the station; this may include for each to see* what is going on the area or road immediately outside of the station area (approaching vehicles, congestion, accident reports, etc.). *This can include third party information/reporting systems such as traffic status from Google Maps and the Waze application. And as appropriate such information is communicated to the passengers by displays in the vehicles or to their smartphone app.

Move: Yes/No/Wait

10 If Yes, the vehicle or the station moves the vehicle to edge of the station zone, and then the vehicle takes over to move out of the zone and enter the public road.

11 Vehicle enters the public road and operates autonomously and in communication with its operation center, and either can communicate its ETA and current (pending status, intent) to the next station.

12 ‘All’ events, ‘performance’, movement data of the vehicle, other vehicles, passengers load/unload, time of arrival/departure, any aberrations, nears misses, performance range within/out-of the constraints/safety-parameters for each routines, weather conditions, traffic, conditions of the station (potholes – using motion sensors on the vehicles), etc. are stored, scored, flagged by respective systems.

Figures 1 to 7

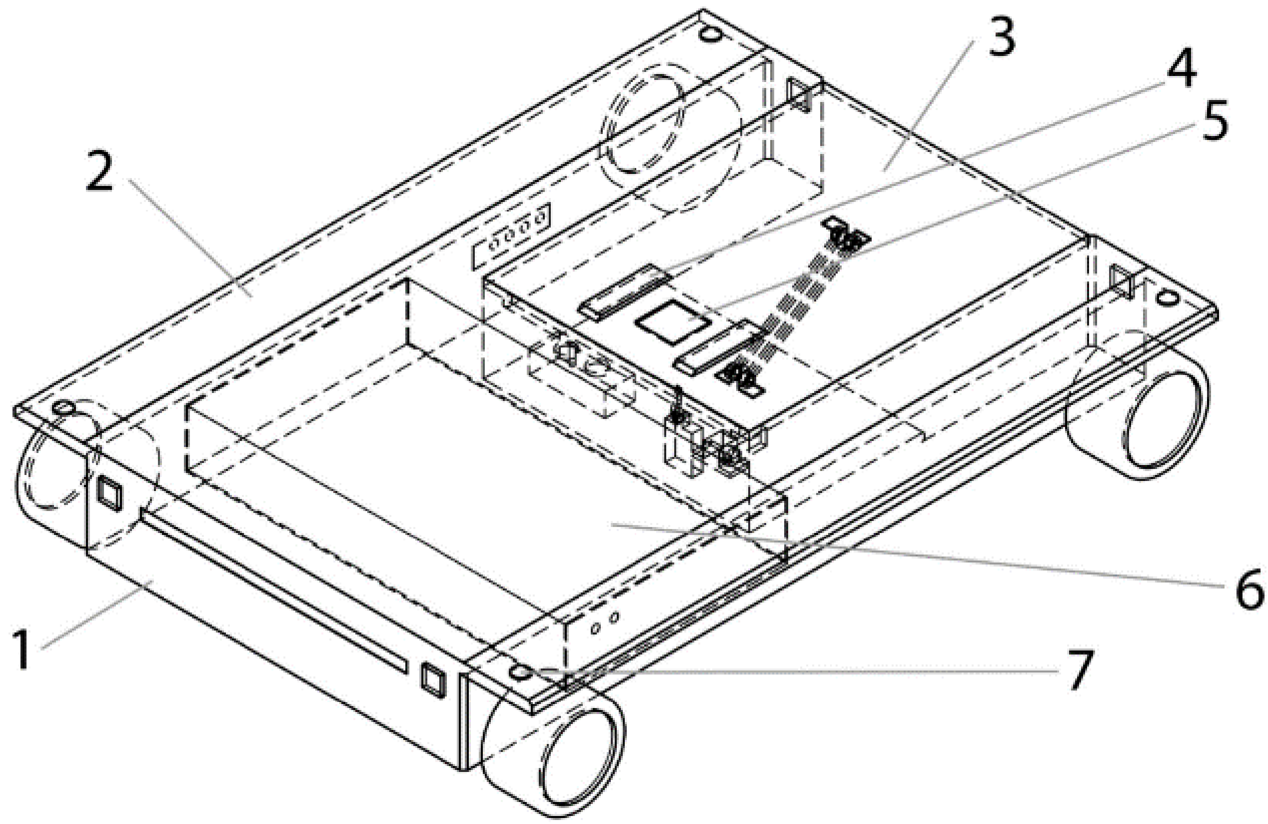



Fig. 1

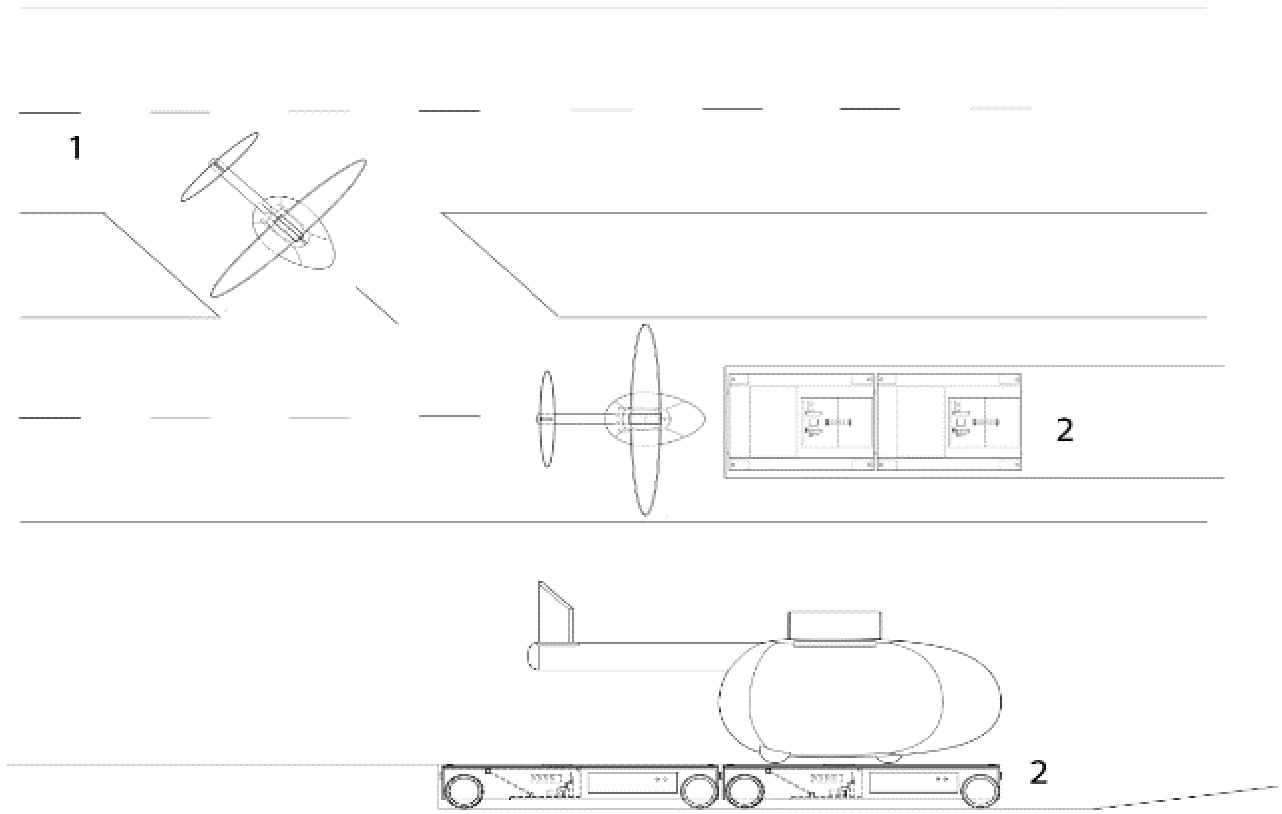



Fig. 2

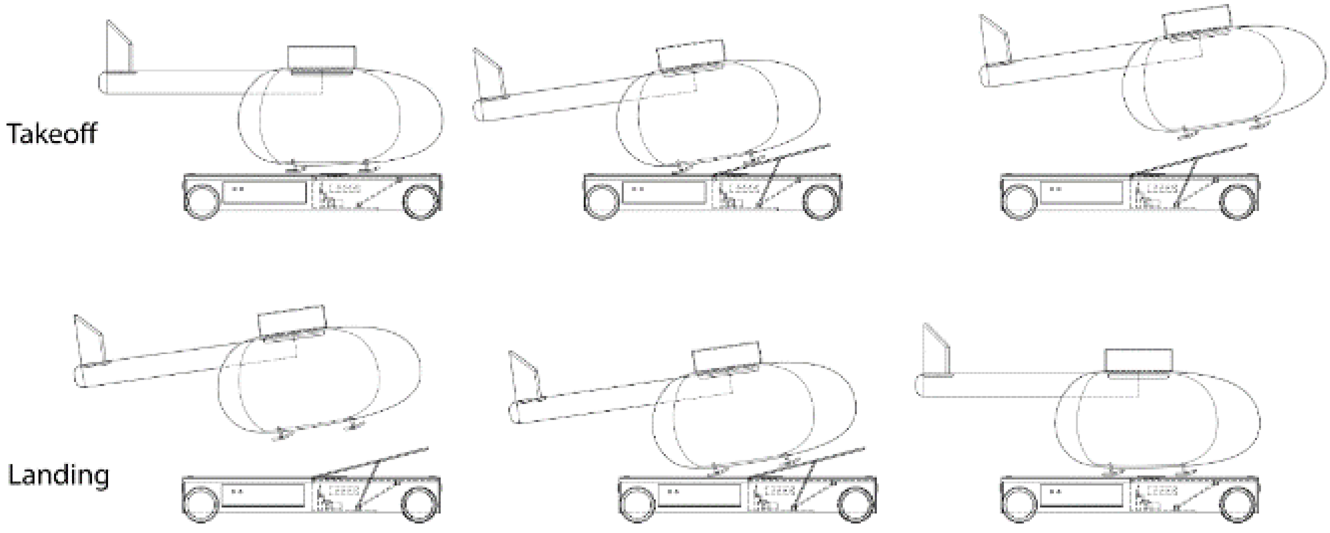



Fig. 3

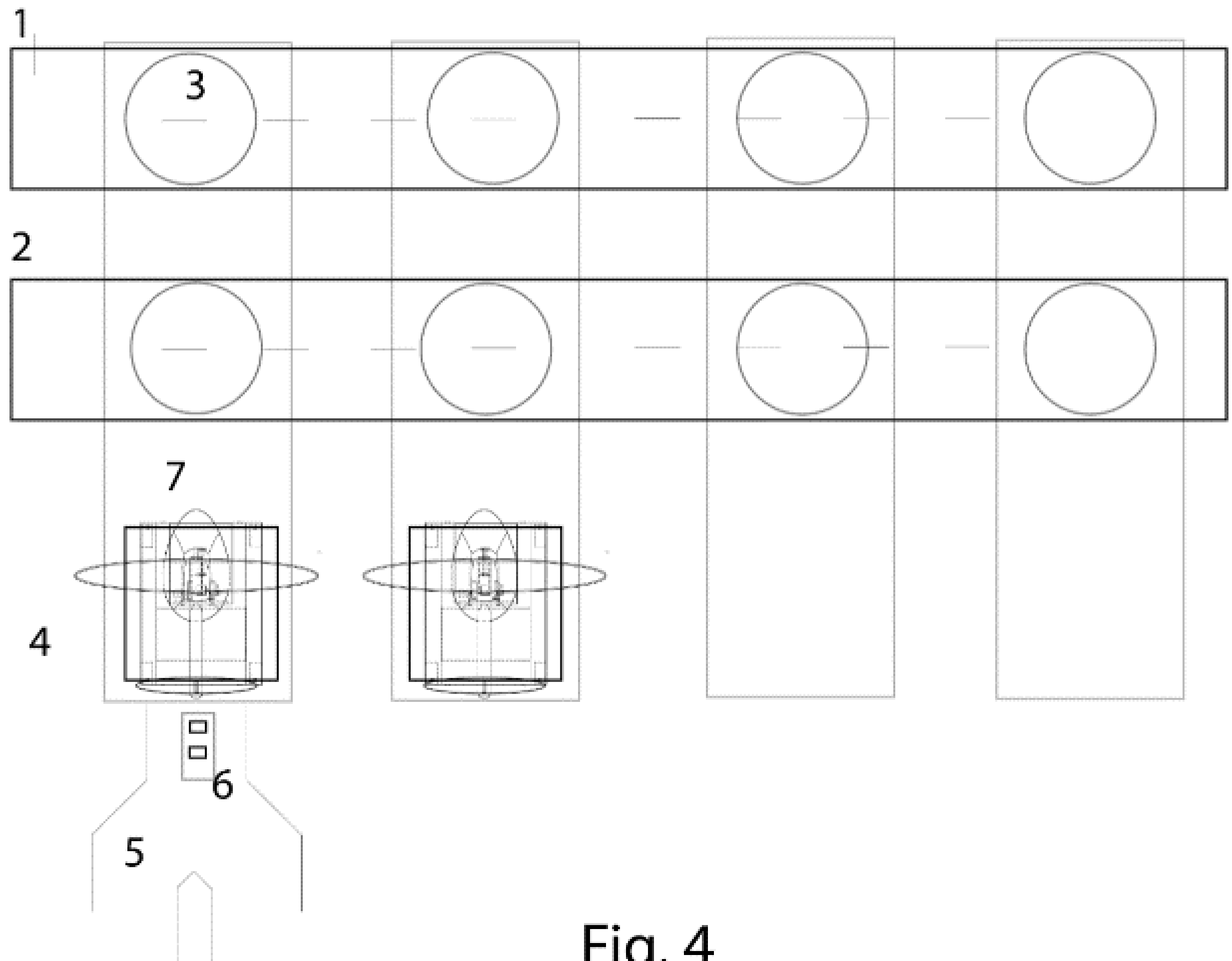



Fig. 4

1189

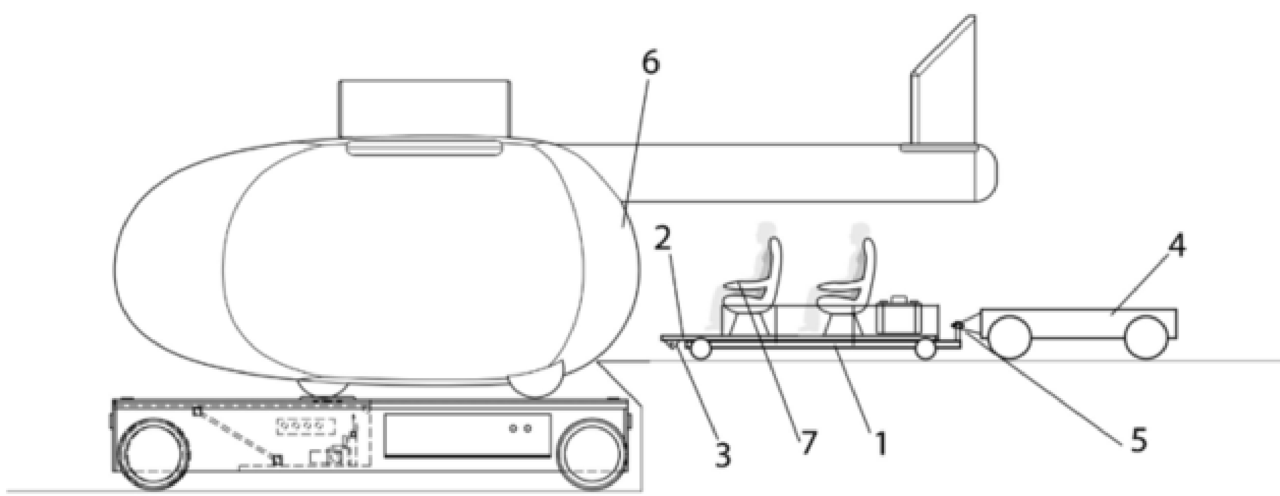



Fig. 5

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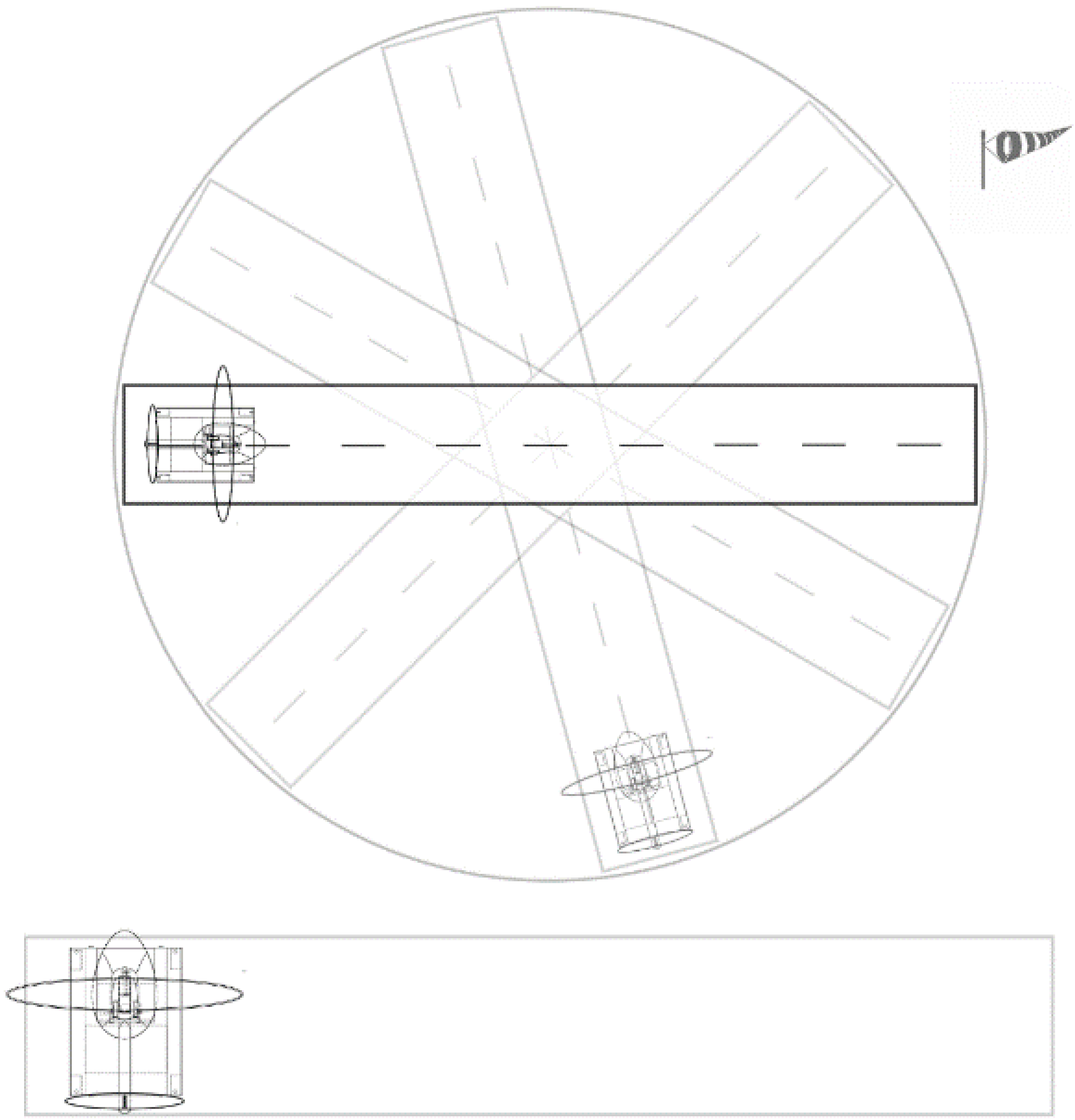

Fig. 6

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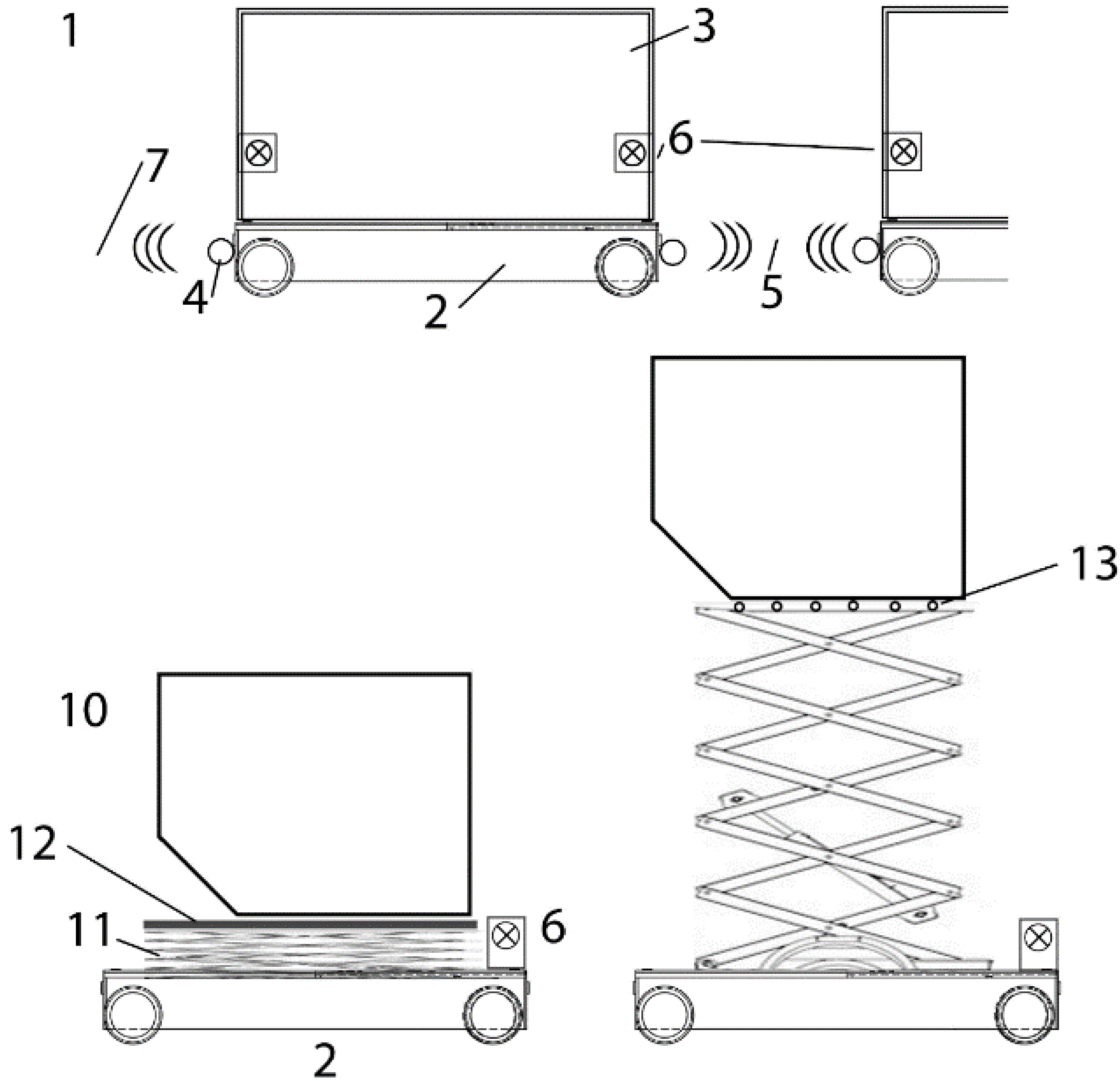



Fig. 7

## Title: Regional Sky Transit System

Inventors: Michael Chung and Aristides Symeonidis

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Utility Patent Application (Provisional)

Regional Sky Transit System

Michael Chung, Aristeidis Symeonidis

SPECIFICATION

ABSTRACT OF THE DISCLOSURE

**[001]** A system of electric aircraft, automotive platforms with electromagnets, and short-runway airports integrated to provide rapid, automated passenger air travel.

BACKGROUND OF THE INVENTION

**[002]** The broadest field of the invention is transportation. Specifically, the invention is in the technical field of aviation. In addition, the invention is in the field of auxiliary ground transportation of passengers, cargo and aircraft.

**[003]** Presently, the state of the technical field of aviation makes private personal aviation affordable only to a minority of people. Apart from prohibitively-expensive private jets, passenger jets in general have significant inconveniences. There are only a predetermined number of routes flown by airliners on a fixed schedule. Passengers must pass through an airport with security and boarding procedures lasting hours, and can only fly to a handful of distantly-spaced airports due to their large land requirements. Passenger disembarking at destination airports adds substantial delay in commuting.

SUMMARY OF THE INVENTION

**[004]** The invention is a system to dramatically improve aerial transportation. This is done by implementing airport, aircraft, and automotive platforms with electromagnets in an integrated and automated way.

**[005]** The invention's passenger aircraft is electrically-powered, seats 2-4 people, and has no bulky landing gear found on every other present passenger aircraft. The lower body of the aircraft is made of a smooth surface of steel, a ferromagnetic and strong structural material. The shape of the aircraft's body fits the ground platform's controllable surfaces and during landing is attracted to the platform's computer-controlled electromagnet.

**[006]** The ground platform is an electrically-powered, 4-wheel, aircraft catcher, carrier, and catapult. The top surfaces are implanted with electromagnets to attract and secure the body of the aircraft during landing, taxiing, and takeoff launching. Ground platforms are equipped with a powerful array of computers and sensors to intelligently perform many functions, thus automating and accelerating the entire sky transit experience for passengers.

**[007]** Making the invention requires using commercially available parts along with custom-fabricated ones. A preferred method: The platform uses a hydraulic piston controlled by an electrical signal from the platform's system computer. The electromagnet capture mechanism on the cart surfaces is constructed by coiling copper wire circumferentially around thin, circular wafer pieces of iron machined from pure iron ingot and then structurally embedded into the flat surfaces of the platform and hydraulic ramp. At least 100 complete circumferential coils of wire should wrap the core. The current flowing through these electromagnet coils must be controlled by the system computer and adjusted by the computer's program's processes from sensors about ambient and operating conditions.

**[008]** To perform a landing, the platform and aircraft both receive an approval key, runway and timestamp from the skypark's traffic management system. As the aircraft's computers or pilot target a trajectory to land at the beginning of the runway, the platform senses the speed and trajectory of the incoming craft with its own sensors and redundantly with a direct data connection to the craft. When the steel undercarriage of the craft is hovering within 10', the computer begins to pulse direct current between 200-1000 Amps through the electromagnet coils to have intermittent moments of magnetization and magnetic attraction, so as to make a gentle but affirmative pull on the craft's body. When the craft has landed on the platform, the platform keeps the electromagnets on in a high-current state to provide additional frictional clamping force while the platform decelerates itself and the onboard craft to the skypark's regular taxiing speed.

**[009]** The invention is an integrated transportation system enabling rapid cadence of boarding, launching, landing, and tarmac taxiing. Transportation is an essential economic and infrastructural service that is an input cost to nearly every other product or service.

DETAILED DESCRIPTION OF THE INVENTION

**[010]** The invention is an infrastructure system able to revolutionize personal and cargo aviation. Specifically, aviation over distances up to 300 kilometers in the near term, and further as commercially-available battery energy density increases. The invention is unique and unprecedented because it is a complete airport, aircraft, and passenger convenience system far surpassing the relatively inefficient airborne transportation available using present aircraft and airports.

**[011]** The platform has a smart full suspension on all 4 wheels by means of an electronically-adjustable shock absorber connected to the platform's computer. During landing, the shock absorbers are stiffened to provide the resistance necessary to avoid bottoming out in a hard landing possibly caused by untimely gusts of wind or other environmental factors.

**[012]** During takeoff, the platform accelerates at a comfortable rate of about 6 $m/s^2$ until the aircraft's takeoff speed has been reached, after which the retention of the electromagnet is turned off to allow the aircraft to begin ascending with its own power. After successfully catapulting the aircraft into takeoff, the platform sends the skypark's traffic management system a signal that it is available to be dispatched to the next task or that it is en route to maintenance.

**[013]** After capturing an aircraft, the platform taxis the craft to an available gate for passenger disembarking and new passenger embarking.

**[014]** The aircraft is designed to be a component of this system optimized for flight travel efficiency. As such no aerodynamic-decreasing landing gear protrusions are necessary by utilizing the ferromagnetic properties of the structural steel underbody for landing and taxiing by the platform.

**[015]** The aircraft is designed to be able to embark and disembark passengers quickly by automatically opening a front canopy at the gate while loaded on the platform. The craft may also be equipped with airbags underneath and aft in the event of an emergency landing without a receiving platform. The stall speed of this aircraft can be less than 50 MPH, and the electric motor can quickly reverse torque to provide braking drag during impact.

DESCRIPTION OF THE DRAWINGS

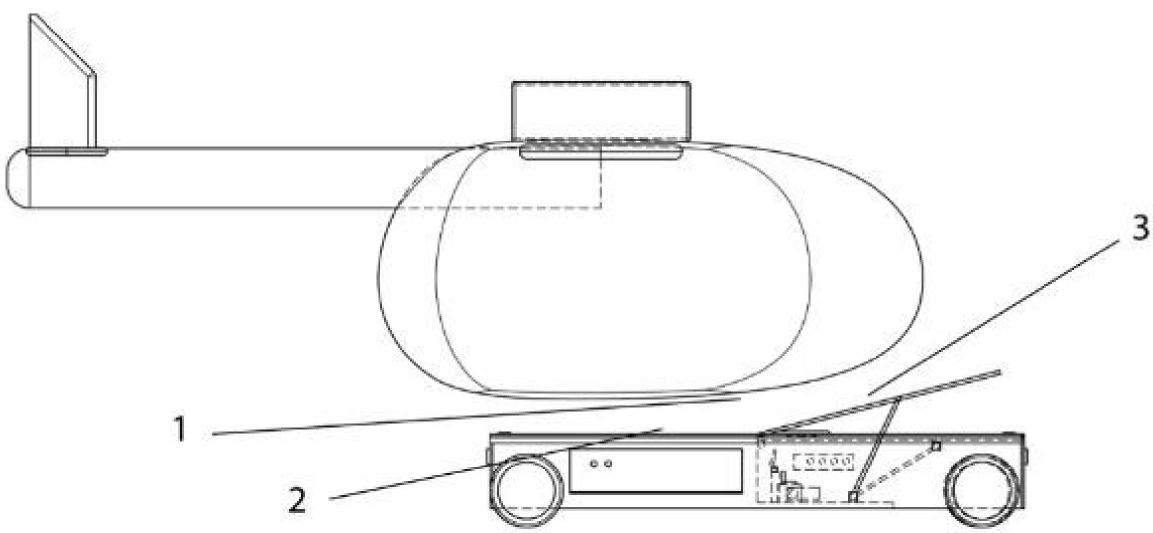



Fig. 8

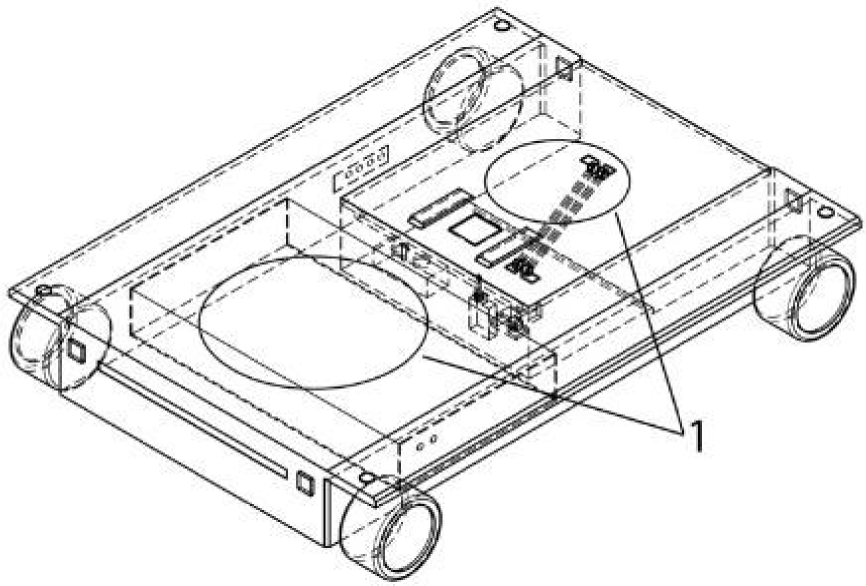



Fig. 9

**[016]** Fig. 8 is a side view of an aircraft landing on the platform with attraction by the platform’s electromagnets. 1 is the steel underbody of the craft shaped to conform to the platform’s receiving shape. 2 is the electromagnet on the flat surface of the platform. 3 is the electromagnet on the optionally-lifted front ramp.

**[017]** Fig. 9 is a view of the platform equipped with circular electromagnets (1). The electromagnet wires are wrapped circumferentially around the iron discs so that the induced north pole of the electromagnet points either directly upwards or downwards, perpendicular to the flat surface of the magnet and the bottom surface of the craft. The instantaneous magnetization of the ferromagnetic material of the craft will be along the magnetic field lines created by the electromagnets, causing a south magnetic pole to point downwards out of the body of the craft, thus attracting it to the north poles of the platform’s electromagnets.

CLAIMS

Automotive platform with electromagnet and mechanical tools to capture, transport, and launch aircraft.

Electric high-glide-efficiency aircraft needing absolutely no landing gear, using a ferromagnetic body material to couple with electromagnet-equipped ground platform for landing, deceleration, and gate taxiing.

Integrated airport system enabling rapid cadence of boarding, launching, landing, and tarmac taxiing.

(Note to reader: Figures are also at pages 61 - 70 of this provisional-document.)

# Title: Out of band authenticating cryptographic memory storage device.

Inventors: Michael Chung, John Sokol

About: A USB or memory stick with cellular communication/data capabilities so that, the cellular capabilities can be used to remotely authorize and authenticate a user and also to track the access of the stored data or its use (e.g., a key).

**In other words: A USB stick with its own cellular authentication channel separate from the laptop - so that, the authentication means is protected from compromised/able laptop (the user can interface or enter authentication information via a separate smartphone application or the laptop browser) – however, this requires a cellular service (e.g., BCCH/USSD). An optional, non-cellular service method is to use – via BLE or NFC – the user's smartphone to 'call the USB stick's authentication service' by tunneling thru the phone, and where the user can input into an UI provided on the smartphone. This tunneling is potentially vulnerable to the phone being compromised.**

A method, system and apparatus for using location tracking and communication (e.g., cellular) data bands to control, track and monitor data on a data storage device such as USB stick (device). The security control (user authentication) is done using a second band and/or additionally with location tracking. This system can be used to give the user access to the data on the USB device and/or to use the USB device as a key to allow access to the object (laptop, equipment).

The objects of the invention:

1) Use of 2$^{nd}$ or 3$^{rd}$ band for authentication of a data stick or device (USB) to give access to the data on the device or for the device to be used as an access key:
   a) A data stick has cellular capabilities (e.g., SIM and data plan) so that it is able to talk to an authentication server, instead of using the laptop that is attached to. This cellular capability is the second channel. The authentication server can verify the location of the device using cellular triangulation (the device would read the available cell towers and transmit such data to the server). If no further authentication is needed, the server would allow access to the data.
   b) In addition to the above, the user could use a smartphone to call the authentication server and go thru user authentication steps. The server would use the data from the device (sent by it over the cellular network) and the authentication process done via the user's separate phone. The separate phone is using a 'third band'.
   c) (Current art is the use of the laptop (the object itself) to do the authentication process, or the device alone (e.g., alphanumeric keys on the device for password), whereas the use of the second band makes would require a hacker or sniffer to access both bands and equipment.)
   d) Also, in either of the above second and third bands, the geolocation of the device and the user can be an additional part of the authentication and usage tracking process.
2) The above method and system can be used to not only grant access to the data on the device, but for the device to be used as a key to allow access to the object, and such uses can be on one device.
3) In the above 1.a. paragraph, the device has its own cellular capabilities. However, this requires the device to have a SIM and cellular data plan. Thus, an alternative is for the device to the Bluetooth (or wifi) capabilities in conjunction with the user's smartphone where the device can tunnel through the smartphone to the authentication server and for its data communication needs.

a) The user can additionally be asked to authenticate to the server. This can be done using the same channel that the device is using or the application on the phone can open a separate channel, or the user can call in separately.

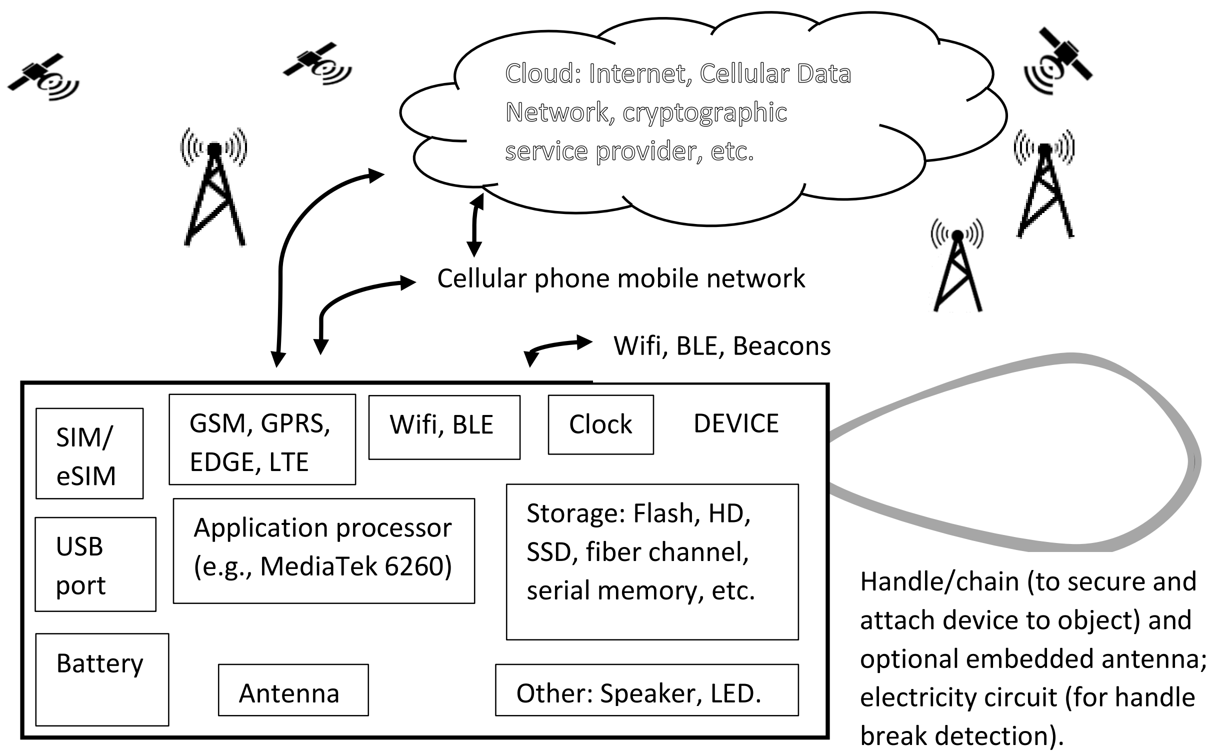
b) The system can also use the smartphone's geolocation as the additional security measure. (In lieu of the device.)

4) If the device has the cellular capabilities, it can be used to track the object that it is attached too.

In one embodiment - the access to the data on the device is granted at designated locations by cloud based permissions, the data and access history and uses are recorded; and the user access is by a separate band – for example by using any phone to call a cloud service/machine and authenticating - other than via the device or at the computer the device is plugged into.

Fig 100 has descriptions, components, methods, systems and embodiments.

Fig 100




As part of the security and authentication processes, the Device talks to the cellular network and/or the GPS services to determine its location (and can store such data in memory or see if they are within the access parameters of the location data stored in its memory); also talks to the cryptographic service provider to do the access-permission processes. This include look up to determine if the Device is in or out of the permitted geo-location or the geo-fence to allow access to the data on the Device and also to authenticate the user.

An optional chain is attached to the Device with electricity conductivity. The Device monitors the conductivity of the chain. The conductivity is used to determine if the chain is cut or removed from the object that the Device is attached to. The object can be a key chain, equipment, or the laptop.

Fig 200 has the basics of the authentication process

Figure 200

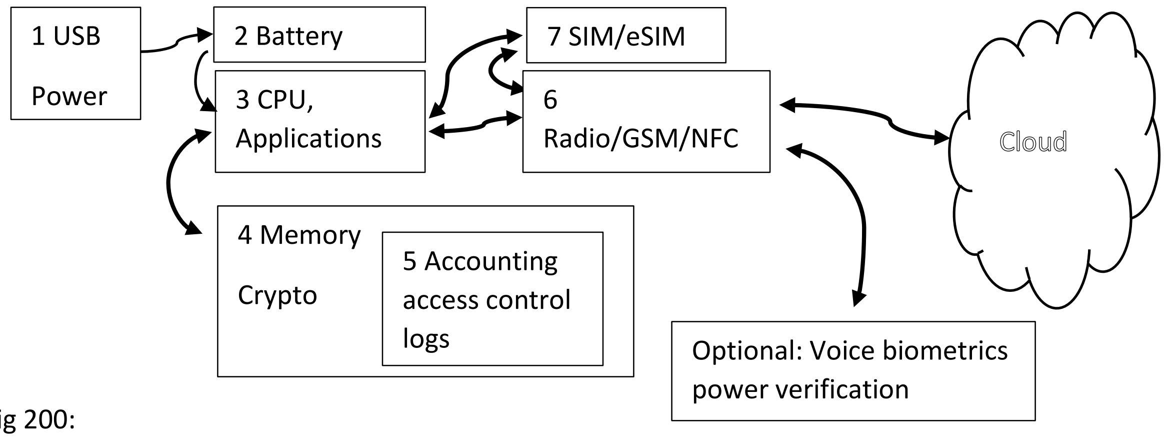



Fig 200:

A portable memory/storage device that reports cell tower base location information to a remote server that then will determine and generate decryption key that will allow a computer access to decrypted data. All use and access to this said storage device will be reported back to the server.

1 The device draws power from a laptop and 2 powers the battery; 3 the CPU retrieves instruction from the 4 memory (and geo-fence information); the CPU communicates with the 6 radio which retrieves 7 SIM information and connects to the cloud. The server returns instructions (e.g., access granting or blocking) to the device. User activities are observed by the server. 8 (not shown) is the conductive break detection chain attached to the Device and its electricity and break detection monitor system.

Features include:

- Access to this device can be remotely tracked, blocked or allowed, geo-fenced (as in limited to certain locations based accesses). The geo-fencing will include one or more of GPS, cellular tower triangulation, wifi, BLE (peer to peer aka crowd-locating; beacons), and FM radio station signals (the individual station call ID are mapped).
- MDS checksums of storage content can be stored, archived, logged in the cloud providing a chain of evidence tamperproof data. Full audit history can also be preserved on the media itself.
- When device is connected to a computer over USB or similar, it can charge a battery and power the device location tracking and send information to the cloud.
- The content or the data provided by the device could change based on the location or unauthorized or failed authentication such as offering a deceptive media image to deter a would be data thief from deeper examination of the storage device.
- The device can also check and/or monitor the activities of the computer that it is attached to so that it can do virus checking, approving or restricting browsing activities (e.g., for children) as well as applications and files on the computer, thus it can act as a key customized for expected users.
- User of a second or third out of band data verification can be done using an AI voiced based system like Amazon Alexa or over Bluetooth to a phone app to verify the proximity of an

authentication application based on the user phone. Or, a call to a call center or the data owner to access a web API to enable data access.

- Additional security methods can include password, two factor authentication and biometrics.
- Also an electricity conducting and/or antenna circuit is embedded in a chain attached to the device and to the device circuit monitoring system so that, if the chain being cut or tampered would interrupt the circuit and can cause to send an alert as well as block access or use of the device.

Location tracking of the device and access verification include matching to the cellular tower data, GPS data, as well as WiFi and other radio (private or public) signals specific to the locations. User will be able to track the location of the device and if lost and cause the device to emit a sound or light.

The device can be attached to a particular location or machine or a computer - so that a user would bring her tablet or laptop to that location and insert the device to her computer to be permitted to only use the data on the device at that location (or if using as a key, to gain access to the machine at that location). Detaching the device would disable the device.

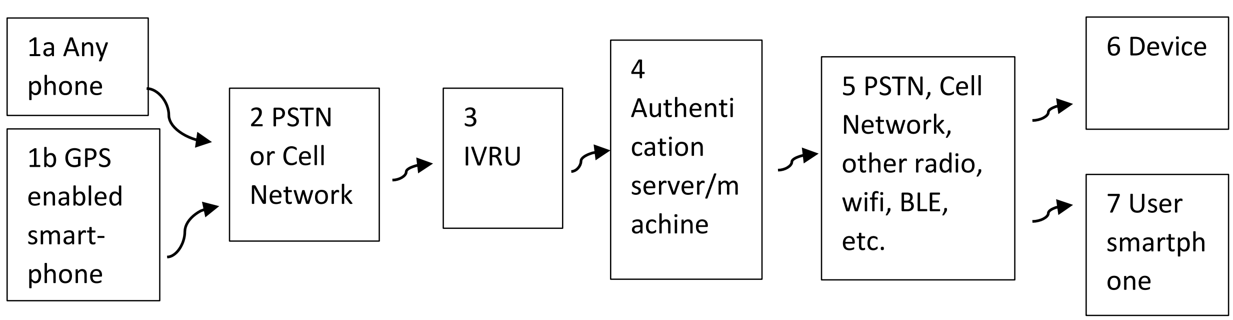
The device can be used to control and equipment to which it is attached (i.e., mated to) – where the device will have geo-fence data and will send instructions to the equipment. Such data can be loaded from the cloud and can be dynamic. Uses examples are rental equipment and drones – where such are given geo-fenced instructions.

Which image the device decides to show depend on the location and the permission granted over the cell network. There may be a default image and ask for verification. The device can look at all the signals (GPS, cell tower, FM radio call ID, etc.) nearby and upload to the cloud and the cloud server will tell it to what type of disk image to show. There can be a honey pot on the device so that if the computer tries to access it, it will respond.

The device does not have to have its own power, but still have the cellular capability. Such will draw power from the computer when plugged in.

Authentication is ideally done using 2 or 3 'separate bands' (as well as separate data channels if using one smartphone) for increased security. The user can use any phone to call an authentication machine and authenticate over the that phone call using voice, etc. Upon authentication, the machine will call the device (if it has the SIM and cellular data capabilities) and give it permission to unlock and grant access. A benefit is 2 separate bands are used so that, if someone is sniffing the device, they will not know the band to be used to authenticate.

Figure 300 – One embodiment and user process



The user has inserted the device into her laptop, and the device causes an image to display on the laptop. An example is instructions for the user authentication, e.g., a phone number to call. At the 1a/1b User calls a dedicated number to 3 Interactive Voice Response Unit (IVRU) to authenticate and to get 4 authorization or unblocking of the device; once authenticated, the 4 server will 5 send authorization permission (code, etc.) directly to the 6 device and unblock it (or in the event of failure, other images or messages the device will display) or to the 7 user smartphone (e.g., the password to decrypt the device data) where the user will manually enter such code either into the device (assuming an alphanumeric keys are built in) or at the computer to which the device is connected. If the user 7 smartphone is different to the 1a/1b, then this is a '3rd band' being used to get authorization. The use of the separate and additional 2nd and 3rd bands to authenticate would make it very difficult or all but impossible for a hacker to sniff the multiple bands.

## Other/Noteworthy:

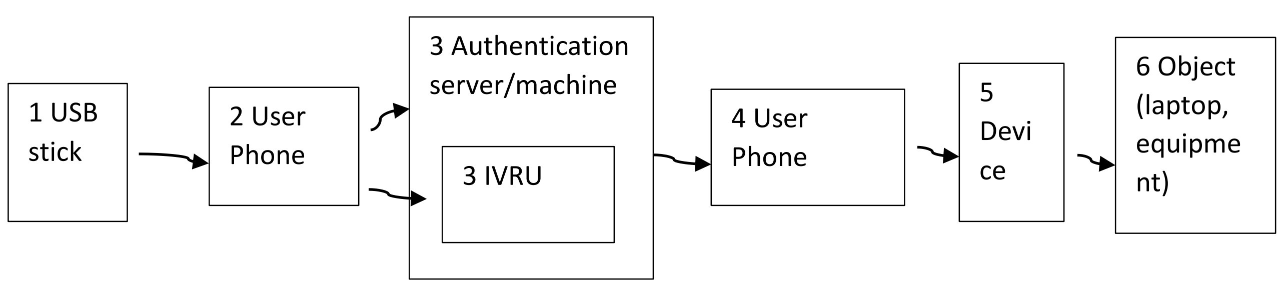
1) If the invention is used as customized key for multiple users:

There can be multiple authentication profiles stored on the device or on the authentication server, i.e., different users are able to authenticate and get their own views and permissions for the device or to the computer or equipment (that the stick is plugged into). For example, a vehicle can allow larger driving range or hours of use to one type of profile or user.

2) If the invention uses the wifi in lieu of the cellular ID/communication network or the Bluetooth:

Instead of the using the Bluetooth to communicate to the separate smartphone, the wifi can be used for the device to communicate to the cloud server. However, if both the object (e.g., the laptop, equipment) and the device are using the same wifi and thus being on one band, a sniffer can easier see the data being passes and the device's authentication processes.

## Figure 400 – One embodiment and user process




1 User inserts device into laptop, the USB draws power from the laptop, and 2 connects to the user's phone (previously mated, registered and authenticated); the device talks to the 3 authentication server, and optionally the user voice calls the authentication server and is interrogated via the IVRU; after the authentication process, the server passes the decryption keys or other access authorizations to the 4 user phone which is then passed to the 5 device, and the user then accesses the device at 6.

## Current Arts – for the USB as a secure data stick:

- “Most people administer and unlock secure USB drives using software apps, which run on the host machines to interact with the drive. That’s the approach taken by the Kingston Data Traveler 4000 G2 (second generation)…(also) available in a managed model…”
- “The other method is to put a numeric keypad on the drive itself that lets the user to unlock it with a PIN. Apricorn’s Aegis Secure Key 3.0 USB 3.0 thumb drive…”

## Current Arts – for the USB as a key:

- “Predator is one of the most popular tools for turning a USB drive into an access control device…As long as the USB drive is plugged in, access to the computer is allowed. USB drives used as keys will remain completely unaltered…Built-in scheduler that can limit computer access to certain times of day.”
- “Rohos Logon Key is a…access control program to create USB keys…Rohos works by storing your logon information and automatically inputting your credentials when the USB is plugged in…features include Secure two-factor authentication by means of USB key + PIN code.”

The above Predator and Rohos use the USB as the key and authentication is done at the USB. The invention uses a separate band as well as the location tracking processes to authenticate and to control access. The transceiver module is by a third party.

## A basic initializing user process:

1. The device is inserted or attached to a computer, and at a user interface/dashboard, the device access parameters* are selected or programmed by the user and loaded onto the device and copied to the cloud server. (*Can include deceptive media image/s; location specific data or access parameters.)
2. Data is loaded and encrypted; and the device is ‘locked’.
3. User desired to access the data at an approved location, and Inserts the device the computer
4. Device collects the location data from the device as well as any that is available on the computer (e.g., the laptop) and communicates with the authentication server. Additional security process such as password, two-factor can be done.
5. The authentication server compares the location and the other authentication data and determines if to grant access to the device’s data storage or not.
6. If granted, the server will send a PGP key to decrypt the data.
7. The session time, the movement of the laptop and/or the device during the session is collected by the server.
8. If the device handle circuit is broken or if the device is lost, the user can remotely disable the device.

(Note to reader: Figures are also at pages 71 – 72 of this provisional-document.)

## Title: A method, system and apparatus, e.g. a smart-rack-storage for multiple tracking and location devices or sensors and to automatically provision and track services (e.g., data, communication).

### Inventor: Michael Chung

This invention document is related to - follows on, has new and additional descriptions to - the provisional application number 62,439,136 filed on Dec 26, 2016 with the title 'Smart remote tracking integrity security seal and system'. This can also be used with the above described 'Out of band cryptographic memory storage device'.

**This invention attempts to address at least 'two problems' anticipated for the coming potentially 'millions' or even 'billions' of IoT devices ('With numbers like "40 billion devices connected in the IoT by 2020" we often get asked where does cellular sit in this future' http://iotdevzone.com). The two problems are related to providing a 'Hardware as a Service' service:**

- **One is the challenges for billing and to set up rates individually and have separate data or subscription plan for each device that will be on the cellular network – thus, the invention offers a new type 'group' plan for the devices in a group (from several devices to 1000s) to be billed as a group.**
- **The other is to: a) physically sort, track and help:**
  - **To manage the several or multiple of such devices that an individual or a household might have;**
  - **And especially for businesses dozens to hundreds to even thousands of device they will use –**
    - **either to field permanently (and thus, their handling up to the fielding),**
    - **or when and if they wish to keep and maintain and inventory of such devices…**
  - **Where when the devices are in the rack or appreciable time, the devices are not being charged for cellular services; and when they are taken out of the rack, to automatically newly or re-provision services, and to charge cellular services.**

In the near future, the use of Cell-ID to track and locate items may become very popular. Cell-ID is a way to use the SIM in the device and the cellular network towers for 'triangulation' of the device. Cell-ID can be in lieu of GPS. An advantage of Cell-ID is that it will require less power and cheaper to track as both the triangulation and the communication is using the cellular network, albeit it may be lower accuracy than that of GPS.

Currently, the cellular phone service providers (in USA) offer family subscription plans where say 5 phones are on a discounted monthly plan. Thus, in a similar fashion if the use of Cell-ID for personal uses become popular, the people may want easier ways to both keep track of the devices and to manage the data services. Additionally, the Embedded SIM will enable cellular services to be provisioned on-demand at the time of use, and perhaps even to turn off as desired.

### Some of the benefits and use cases:

- Rental equipment businesses may wish to attach the Trackers to their equipment. And when the equipment is returned to detach the Tracker and to be able to easily place it into a mount to be recharged and ready for next time.

- Also, while the tracker-devices can have single charge battery, there are benefits to having rechargeable battery. Thus, it can be beneficial to have a rack where the Cell-ID devices could be recharged by either contactless or by inserting into charging ports of sleeve.
- Also, there the possibility that shipping services (e.g., the UPS, FedEx, DHL stores) may have these Cell-ID device-tags that they may wish to attach to packages and to track them. Thus, they would have the tracker device tags in bulk. The bulk units can be on the rack or a tree (vs. the rack form) and can be detached individually or come in a rack to be individually removable.
- Where the data charges are based on a bulk rate – e.g., the group (trackers) use basis instead of individually. To turn the tracking services on and on demand, e.g., by returning to the recharging mount (can add a delay).

Also, a manual on/off switch on the Tracker can be used to turn the service on or off and to have a LED that indicates if the Tracker's Cell-ID service is on or not. When the tracking service is turned off, the tag (or the rack, if the tag is inserted back into it) can send such communication to the such data and tracking service provider. Also, the rack can be used for sensors that require a form of communication and/or location/tracking services - for example, LoRA embed sensors.

In addition, there may be uses where businesses may have numerous tags that they wish to use within the confines of their own facilities where there are beacons and wifi tracking capabilities, or other radio tracking means. These tags include BLE, Wifi and RFID tags. They may wish to use a rack like apparatus to store and track the tags (i.e., even if they don't have a cellular tracking service).

In addition, while NB-IoT devices are expected mostly to be fielded permanently and for single use, their handling and management can benefit from such as the rack or the tree so that, they can be purchased in bulk and on when activated to have cellular data/communication service to be activated. FYI:

- 'NB-IoT focuses specifically on indoor coverage, low cost, long battery life, and enabling a large number of connected devices. The NB-IoT technology can either be deployed "in-band" in spectrum allocated to Long Term Evolution (LTE)—…—or "standalone" for deployments in dedicated spectrum. It is also suitable for the re-farming of GSM spectrum.' Wikipedia.
- 'Operator Commitments to NB-IoT Will Push Cellular M2M Module Shipments Past 400 Million in 2021… Tracking, as well as simple thing monitoring and control, will be the primary application segments for NB-IoT. With decreased technology requirements enabling long battery life and greater coverage, tracking of all types of products will be possible…In time, NB-IoT-based devices purchased straight from a local supermarket should be available to consumers for sharing economy applications.' iotbusinessnews.com/
- 'NB-IoT enterprise application size is expected to grow from USD 320.5 Million in 2017 to USD 8,221.3 Million by 2022…' MarketsandMarkets
- 'Place the LoRa™ Tag on your key chain holder, in your hand bag, around the neck of your favorite pet. Press the button once to send your code 1, press the button twice to send your code 2…' http://ingecom.ch/
- 'With numbers like "40 billion devices connected in the IoT by 2020"... The answer (partly) lies with what the 3GPP standards body are doing with the LTE Category-0 and LTE-M proposed standards. These two standards directly address the M2M & IoT device market segments with their properties.' http://iotdevzone.com/blog/2015/05/18/lte-category-0-lte-m-low-power-m2m-device-roadmaps/

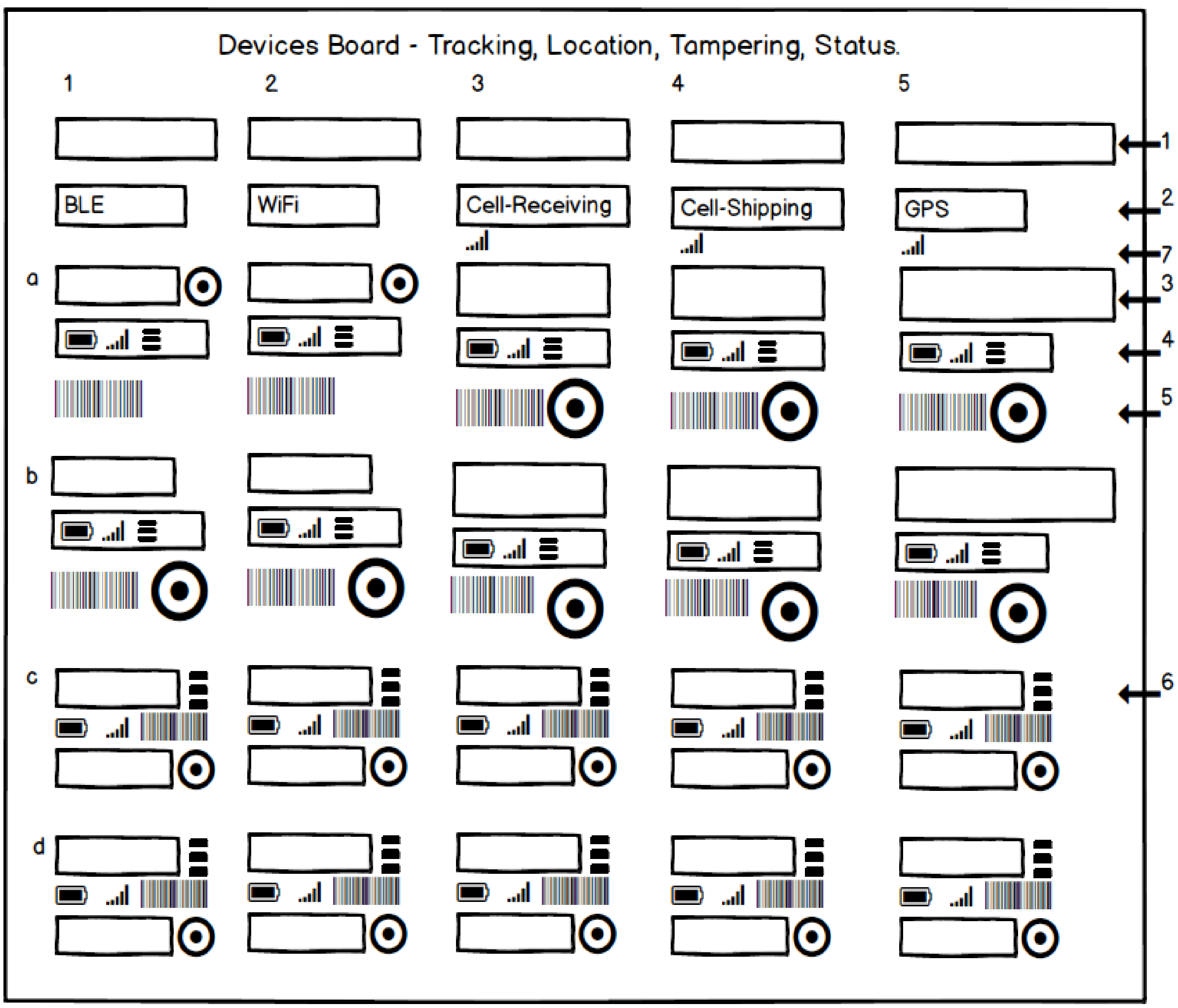
**Cellular data/communication for tags and M2M as a utility ('Cell-IoT as a utility (i.e., 'cellular services on tap') Service') is enabled. I.e., a barrier is the individually managing the data/communication costs and is also being addressed in this invention.**

The invention includes the means to use (and to pay for, be charged for) cellular data or communication service for the cellular services for a group of Cellular IoT devices so that, they do not have to be individually or separately be charged. Thus, a user of such grouped devices can be billed for a collection of such devices.

One way is for the rack to have its own SIM chip/card and also that all the devices to be initially associated with the rack is logged by a cellular service reseller/distributer. Another way is for new devices to be associated with the rack at their use event in-the-field. Another way is for the rack to not have its own SIM capability but to have an account number and for the devices to be associated to the account.

The uses are tracked and if within the pre-set amounts, the rate is the pre-set bulk rate. If it goes over the pre-set use amount, additional charge can be assessed.

Fig 100



The figure shows an embodiment of the rack. It shows for multiple tags/sensor types. However, it can be for one type. Some of the components of the rack.

- A processor, memory, operating system, etc.
- Powered by electricity or battery; one or more antennas as needed i.e., RFID, BLE, Cellular, LoRA; optional network capabilities for transferring data on the individual devices to the server.
- The rack itself can have a cellular communication capabilities and its own SIM. The SIM can have a bulk data account with a cellular data/communication service provider. (Albeit like a family cellular data plan.) It can be a hub and a gateway.
- Wifi, BLE or other communication capable to talk to the server to communicate its status, that of the individual or group of the tags that are mounted in the rack.
- Wifi, BLE or other communication capable to talk to the individual tags that have been mounted into the rack – e.g., to get the status of the individual tags. This can be by BLE, NFC or by contact with appropriate exposed/connection with such designed tags.
- Wifi, BLE or other communication capable to talk to the tags that were previously mounted/stored in the slots and are now in use and are within the range respective radio capabilities. E.g., it can act as a hub or gateway for various BLE tags to communicate over wifi or cellular service.
- There is one or more of electronic connection or I/O on the rack such as I2C, SPIRIT, Serial.

Figure 100 information:

1- Is optional screen for displaying text or images for that column of the tags.

2- Is the name of the tags/sensors collection in the respective column. This figure shows Cell Receiving and a Sending slots. Each column collection can be dedicated to a particular use.

   a. The UI symbols that will be displayed in the (4) item can give feedback and results of the use of the device. E.g., if a device is removed from the Shipping slot, and attached to an object and shipped, once it arrives at its destination address (can be tracked GPS, Cellular triangulation, BLE), and the package open detection is triggered; such information is sent back via the cloud (device talks to cell network > to the cloud > to the device's tracking service provider/server > to cloud > to the rack's local area network (or direct to it via cellular communication capability if enabled; and the result is that the rack can give back the status of the device.

   b. An in-the-field device can be deactivated; its data service turned off – either at the rack or by a user application. A new device can be now associated to the slot.

3- Is the slot for the tags or sensors and where if the devices have ports such as the micro USB or the Apple Lightening then preferably on the inner-back side (the recessed inside part) of the slot are counterparts for the plugs for powering the devices or for data transfer to or from the individual device. The data and power can be transferred by contactless means is such are enabled on the rack and the device.

4- Is a display to show the battery level of the device when mounted into the rack; if the device is in communication to the rack or via an application (and then from the application to the cloud to the rack's operating software/application server), then it can show the battery level of the in-the-field device; also can show other status of the device such as its signal strength to the rack; and the 3 stacked image (the hamburger) is representation of other status information, such as if the device is still operating properly, if the sensors are still at the being-monitored state, etc.

5- Optional bar code for the slot and can represent the device assigned or associated to that slot – so that, a scanner can scan/read the code. The circle represents a touch pad or button for various purposes – e.g., if a biometric reader, can read the thumb of the user; or if a button function then to turn on or off the cellular data service on the device (unless set to automatically turn on or off as the device is removed or inserted back in)/
6- This a variation of another type of configuration and the UI layout and assumes the device to have the same contact area with the slot.
7- The amount of cellular data and communication, i.e., from the 'monthly' allocated to the rack can be displayed so that, the user is aware of the amount of data usages for billing purposes.

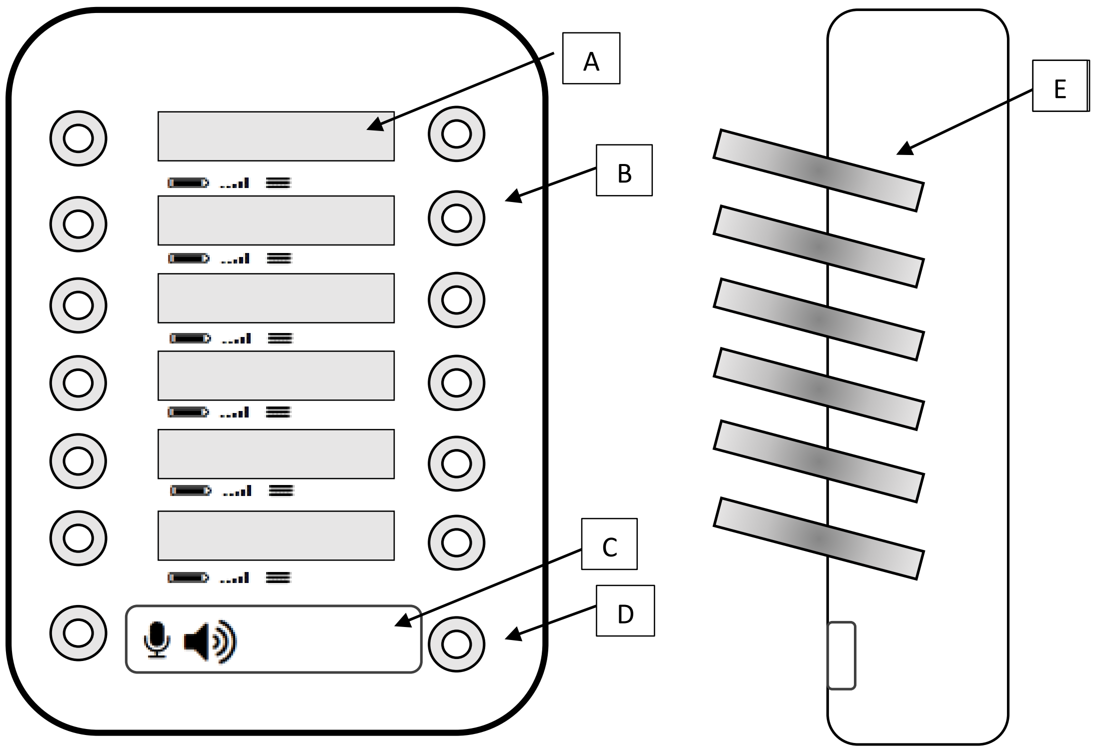
Additionally:

- Mobile app or web application can have substantially similar user dashboard and view where, the activities at the rack and the instructions at the dashboard are sync'd; for the user to control the devices' state from the dashboard.
- Also the application can show the location and additional detailed information of the device; as well as the current amount of the 'data plan' used (similar to how our mobile service provider and the mobile phone gives us amount of data used by the phone, etc.)

## A general use sequence:

1- The devices are inserted into the rack at the point of their assembly (at the factory). Let's say that the devices have embedded SIM.
2- The rack is sold by a distributer to a customer user. Let's say that the SIM of the rack and all the other SIMs of the devices are registered by the distributer with the cellular service provider.
3- The user installed the rack at home/warehouse, powers on; turns on the 'main' SIM in the rack.
   a. The SIM talks to the designated service provider and provisions for data service.
   b. If the 'bulk rate' service is set up, then the service provider can know all the other SIMs (IMSI) information that have been previously associated to the main SIM.
   c. The service provider may or may not begin charging for the data/communication service; or wait for the first device to be removed and or turned on for the service charges to begin.
4- The user removes a device from the rack – the device is activated, and separately provisions for its own SIM activation.
   a. The user attaches the device to an object to be tracked or monitored.
   b. The tracking information, other information on the device is sent from the device to the cloud and to the distributer (assuming the distributer is also providing the application service) for the rack. Or, the application and the cloud related service can be done by another service provider (i.e., a reseller of the cellular network service).
5- The device is tracked or monitored.
   a. Its information can show on the rack as well as available via the cloud.
6- The user returns the device back to the rack.
7- The device senses/knows that it is back in the slot (this can happen one of several means, including a manual turn off by the user via the application, or via a manual means at the rack).
8- The data service on the device is turned off by the cellular service provider.

Fig 110 – Other embodiment for the rack – a ‘home use tag rack’.




Above is a rack for small tags/devices such as TrackR, Tile, (both are currently BLE only); and Pinggps (a cellular based tag). Left image is a front view and the right image is a side view (with representation of the tags inserted into the slots)

- A- The slots for the tags/devices. May have charging capabilities – by plugs or contact.
- B- Represents touch controllable interface (buttons) or lights – to turn on/off the respective device, and for messages or feedback to user.
- C- Represents the various user-interface features of the rack itself such as microphone, speaker, wifi capable, battery level if battery powered, etc.
- D- Represents additional control options for the rack, such as on/off.
- E- Represents the tag/devices in the rack.
- F- (Note to reader: Figures are also at pages 58 – 59 of this provisional-document.)

(Note to reader: Figures are also at pages 73 - 74 of this provisional-document.)

## Title: A method, system and apparatus for - personal messaging devices - using messaging and signaling devices and cellular network and cellular technology.

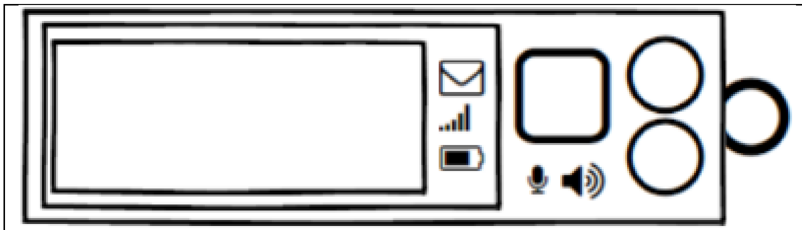
Inventor: Michael Chung

**In other words: A cellular-lite or texting-lite personal communication device – so that, say up to 160 character message can be sent and received device to device, or certain and limited forwarding from the user's un-attended smartphone, so that, a user can be w/o her phone and yet still get some messages. 'USSD messages are up to 182 alphanumeric characters long' (Wikipedia)**

A device that is cellular communication capable such as using the BCCH and USSD to enable users to send short messages to the display in the target device or to cause to display, make sound, vibrate, etc. from the stored memory of the target device; so that at least the following benefits can be achieved:

- A device other than a mobile phone for communicating over the cellular network at lower bandwidth, use the cellular triangulation (via BCCH, USSD) for tracking/locating the devices (in China accuracy is within meters in urban areas using just the cellular based location tracking)
- The lower cost of using BCCH and USSD over the general larger 'streaming capable' data service.

Fig 200 – a 'message-lite 140 character' cellular (USSD) service device. A pager for 21st century?



Display for messages; message, signal, battery indicator; touch-sensitive control; microphone (for voice to text), speakers for sound, rings; 2 buttons for n functions; key chain hook.

Markets for the device include under developed regions where voice calls and smartphone are a luxury. Also, a soft key pad – which can wrap around the device - can be attached to the above device.

Also, 'One-third of Americans prefer texts to voice calls' (CNN, Sept 2011); thus a user could 'leave their phone' home or car and only carry the invention device for certain periods of time/activities (e.g., dinner with the in-laws) and remain connected*; especially if their phone and the device is 'tethered' virtually 'in the cloud' so that, a text message to the phone or a call to the phone – could be 'copied' to the device, albeit in abbreviated form' – such as sending only the caller's phone number or beginning part of their text --- i.e., whatever can fit into 160 character 'limit' (per below). *NB-IoT will be able to penetrate deeper into buildings than that of current cellular communication.

The follow is a description of a prior art – a patent pending technology available by a third party technology startup to enable the cellular related functions of this invention:

> '…(our) module, whether 2G, 3G, 4G of 5G, does not support a data channel. Quite different from Cat1, CatM, NB-IOT, etc… http://iotdevzone.com/blog/2015/05/18/lte-category-0-lte-m-low-power-m2m-device-roadmaps/ … LTE (4G) this would require a new design and new chipsets…the frequency bands are different. LTE cat 1 (or 5) will be the one focused on IoT: low power, low bandwidth, low bit rate… [our technology is] a cellular module that only uses the control channel and does not support data or voice communication. USSD transport makes cellular module cost effective for global deployment…[but] to limit the length of each transmit session to one 160 character message…'

The above module can be used; however, the subject invention can utilize other cellular capable chips (MediaTek 6020, etc.)

Also, although the invention focuses on BCCH/USSD, the general data service is optional, especially as the cost will come down; and especially if based on ‘capped uses for texting and sending activation commands to the’ target devices; and other communication standards that are and will be developed:

‘With numbers like “40 billion devices connected in the IoT by 2020” we often get asked where does cellular sit in this future. The answer (partly) lies with what the 3GPP standards body are doing with the LTE Category-0 and LTE-M proposed standards. These two standards directly address the M2M & IoT device market segments with their properties.’ LTE Category-0 & LTE-M low power M2M device roadmaps. Andrew Leckie. 18 May, 2015

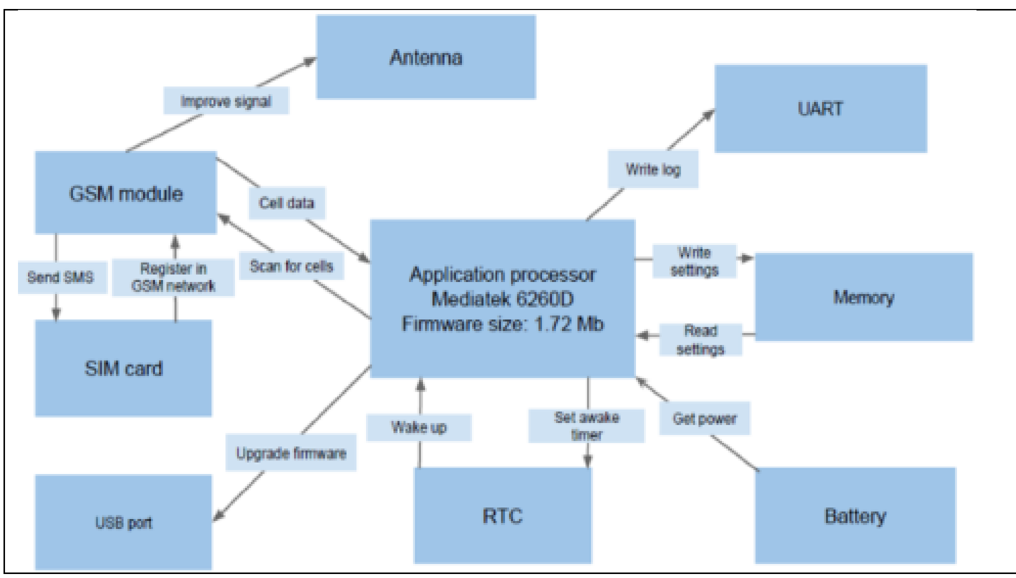
Another prior art: US20160286355

Title - ‘System and methods which use low wireless data bandwidth consumption for tracking wandering devices’; ‘A system for monitoring locations of each of a population of wandering devices, each having localizing functionality…’; and a claim - ‘11. A system according to claim 7 wherein said low-reliability communication channel comprises USSD.’ Pub. Date May 14, 2015.

The intent of this invention disclosure is to build additional methods, systems and apparatus ‘on top’ of above module to enable new applications --- i.e., the above prior arts seems to include the use of particular communication channels as inventive; however, both seems to be teaching only for the tracking and location purposes of the object device; and, it is expected that the host of M2M devices (e.g., sensors such as motion, temperature, tamper-detection, etc.) will send data and communications among each other and to the cloud/server --- <u>thus, the invention teaches particular new applications possible on top of the above prior arts, where a user can send-push and receive short message (e.g., if BCCH, then 160 characters or less) or instruction that cause an action from the device’s stored memory.</u>

## Fig 210 – A cellular module

(An earlier generation of module (image) for cellular based location and tracking service; with added description of the invention components and system to enable Fig 200)




A cycle for location – tracking, communication: 1-Device wakes up 2-Registration in network 3-Scanning for available cells (for location, at least 3, information stored in memory) 4-Sending/receiving data over BCCH/USSD 5-Optional – go to sleep until next wake up time (to save battery).

Additions/modifications to the Fig 210

1) Added to an updated version of the above (e.g., SIM can be replaced by Embedded SIM; the processor is replaced by 3G, 5G capable; and as needed, additional BLE and/or Wifi capabilities; are larger memory, RAM or ROM, etc.
2) As the product/customer features warrant: Microphone; speaker; LEDs; buzzer; camera; display for text, images; user buttons; sensors; etc.
3) Capabilities to update the memory as well as the firmware/operating system at the factory; by the service provider; by users over the air/on-demand – from mobile applications; by approved third party application developers.
4) There is one or more of electronic connection or I/O on the device such as I2C, SPIRIT, Serial.
5) Software: Voice to text, image display, etc.

## Fig 220. A sequence for one to many communication

Device A user enters and pushes the user selected/created text (entered via text pad, voice to text, or from a pre-stored selection visible on the device’s display) using an app, WAP.

Device additionally sends (based on configuration, and instructions in its memory) its location and/or other general or specific information (which can be used by one or all of the following). The service provider’s protocols are used for the messages and communication.

Message sent to Cell operator; or Wifi to the Rack (then Rack to the cell operator).

Cell operator forwards/copies message to the Device’s service provider/server (USSD is not a store and forward intrinsically); optionally waits for authorization to forward the message (functions at service provider include: recipient lookup; authentication of sender; etc.; encryption/ decryption (if being used); reviewing the status data sent by the sending Device (e.g., its geolocation, etc.) then pushing/authorizing send of the message/instruction to the recipients’ devices.

To Cell towers (if cellular service); if the devices are local network then wifi to the Rack’ etc.

To Devices B and/or C – the text is displayed; a LED lights up; a sound is made.

To Devices B and/or C – sends delivery confirmation back to Service provider.

BTW: IPhone may not allow user to read or write USSD code. Thus, the device service provider’s application can be installed on such user’s smartphone, or Wireless Application Protocol is used. The application talks to the service provider and then the service provider sends (e.g., via the cloud and cellular service) to the recipient’s device.

Some limitations of the BCCH and USSD include:

‘…for LORA and SkyFox in Europe, the regulation limited the length of the message to 140 bytes and 8 messages per day. For the same network in the US, the regulations limited to 140 bytes per message and to a reasonable number of messages per day (no hard limit but it is assumed no more than 10 to be save)….(I believe) the same thing is valid for USSD: a reasonable number of messages per day. It is not a tech limitation but more a carrier-imposed limit (although the limit may be much higher than LORA).' (Perhaps, for a family-group users, they can share the 'limits' as described in the Smart-Rack-Storage.)

Additionally, it is possible for the devices to be used with the previously described rack (i.e., 'A method, system and apparatus, e.g., a rack, for multiple tracking and location devices or sensors and to automatically provision and track services (e.g., data, communication)').

The rack itself can have speakers and microphone, its own LEDs, and display. A purpose is that if the receiving device B or C is say, connected via BLE or wifi to the rack; then a message, song, or etc. stored in the rack can play on the rack's speaker, or device. E.g., device A user can send a message to his wife (presumably carrying the device 'B'), so that if she is home or when she comes home, the rack will play a song over its speakers.

Other uses include:

A pet dog can have a device on its collar as is let to roam the park or neighborhood; the master can cause a whistle to sound in the device, or a prerecorded owner voice --- in order to instruct the dog to come back home.

The commands can be done with the following:

- Button/s on the device; a virtual keyboard on the device.
- A smartphone/mobile app that has been previously mated to the either the rack (associated to the devices), or the grouped devices; where the user can open the app, see the location of the device; and pull up a menu with messages/instructions/actions to send and to happen at the device.
- Vote – 2 buttons; lights up; beeps; buzz' not VM – too much; one button to

Other use cases of the devices and the service:

- There are a grouped associated to the rack, the rack is mounted at home. Connected to the wifi as well as cellular enabled (e.g., has its SIM)
- The device has LED lights which can be for particular purpose, e.g., one-to-one or many communication from a device registered to the wife/mother cam cause the red LED light to be displayed at the downstream devices when the message/action is done.
- Husband can press a single purpose assigned button on the device – to tell the wife that he is leaving the office and coming home.
- A grandparent at home can press a button, to tell her son/children to call her.
- If the sensors (accelerators, motion) in the grandparent's device is 'not moving' beyond a set parameter (or the device has 'wandered' outside the preset geo fence, the downstream devices can be alerted. Either the device can send; or upon periodic polling by the rack and/or the service provider for the rack's location; or upon polling by the downstream devices.
- A user can set up the registration at the time of purchasing the devices and/or the rack; or can be registered dynamically. The registration can include registering the rack/device to the grandmother's home wifi prior to the shipping.

(Note to reader: Figures are also at pages 75 - 76 of this provisional-document.)

**The figures to the preceding parts of this provisional-document.**

Title: Methods, systems and apparatus for autonomous robot platform - for assisting small airplanes to land, takeoff and move; also for cargo carts and passenger pods; and related, for airports; and control and management of driverless for hire or mass transit vehicles at their depots and passenger stops.

Inventor: Michael Chung

Figures 1 to 7, 10, 11

Inventor: Michael Chung, Aristides Simonides

Figures 8, 9

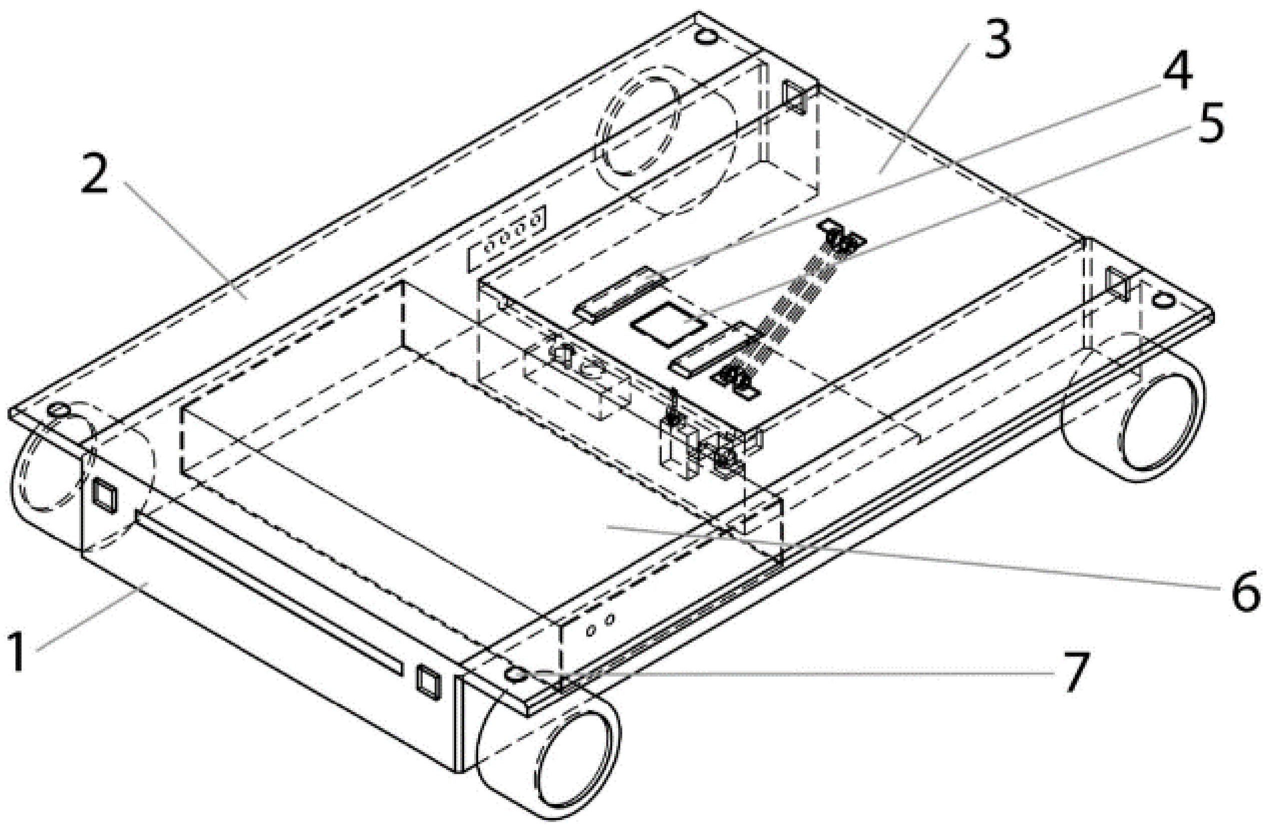



Fig. 1

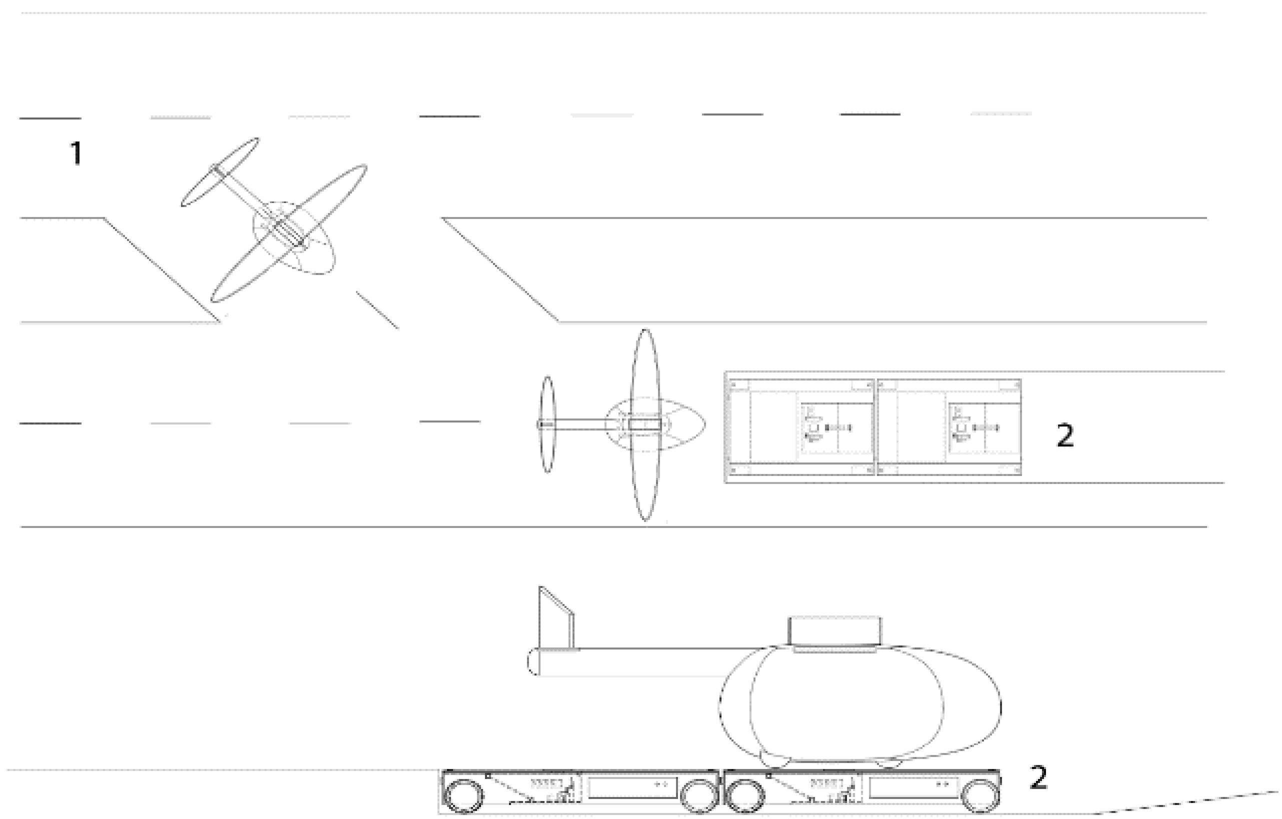



Fig. 2

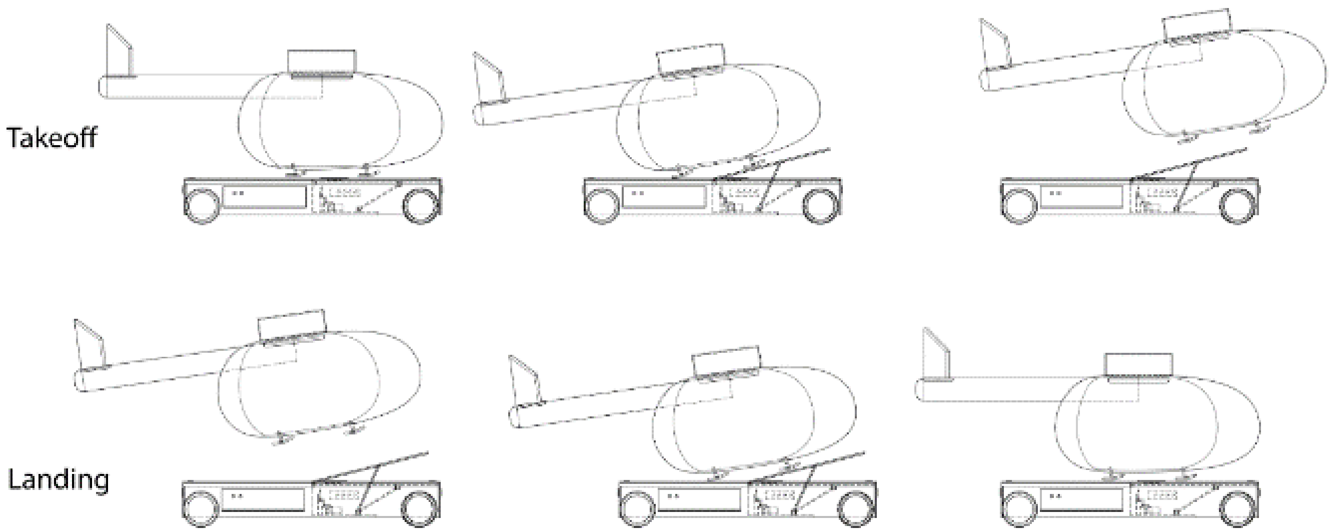
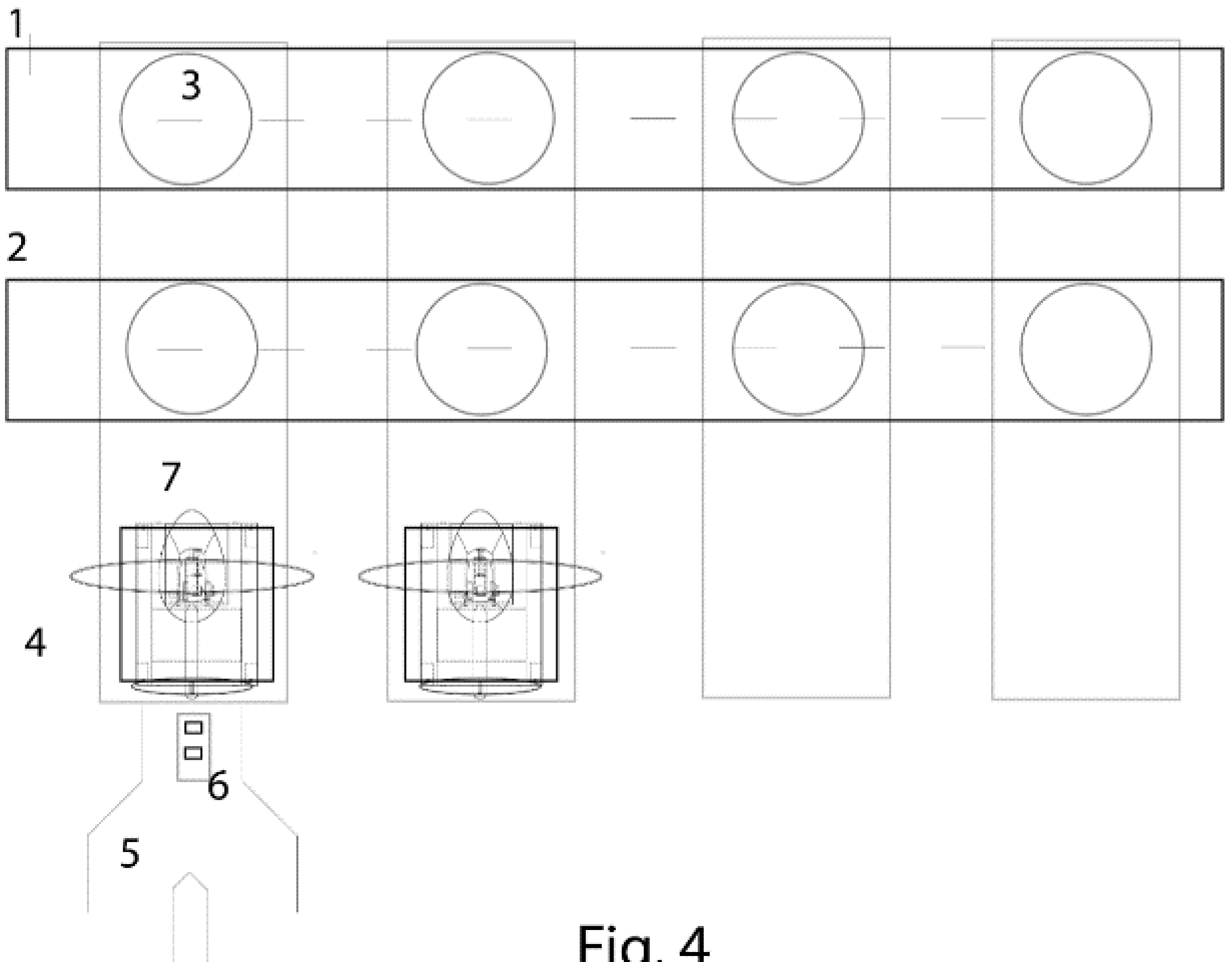
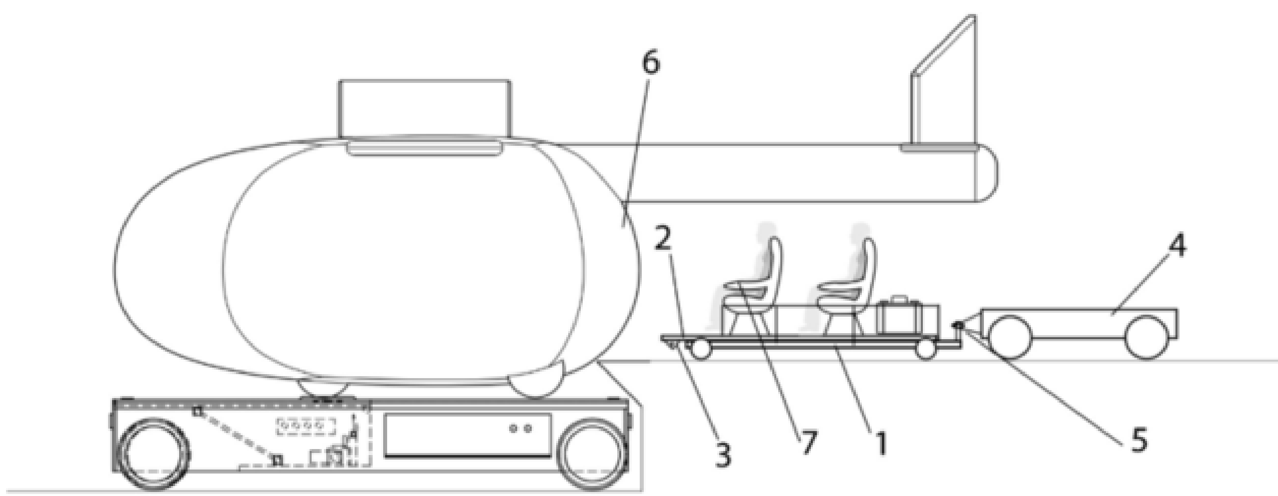



Fig. 3




1883 Fig. 4




1884 Fig. 5

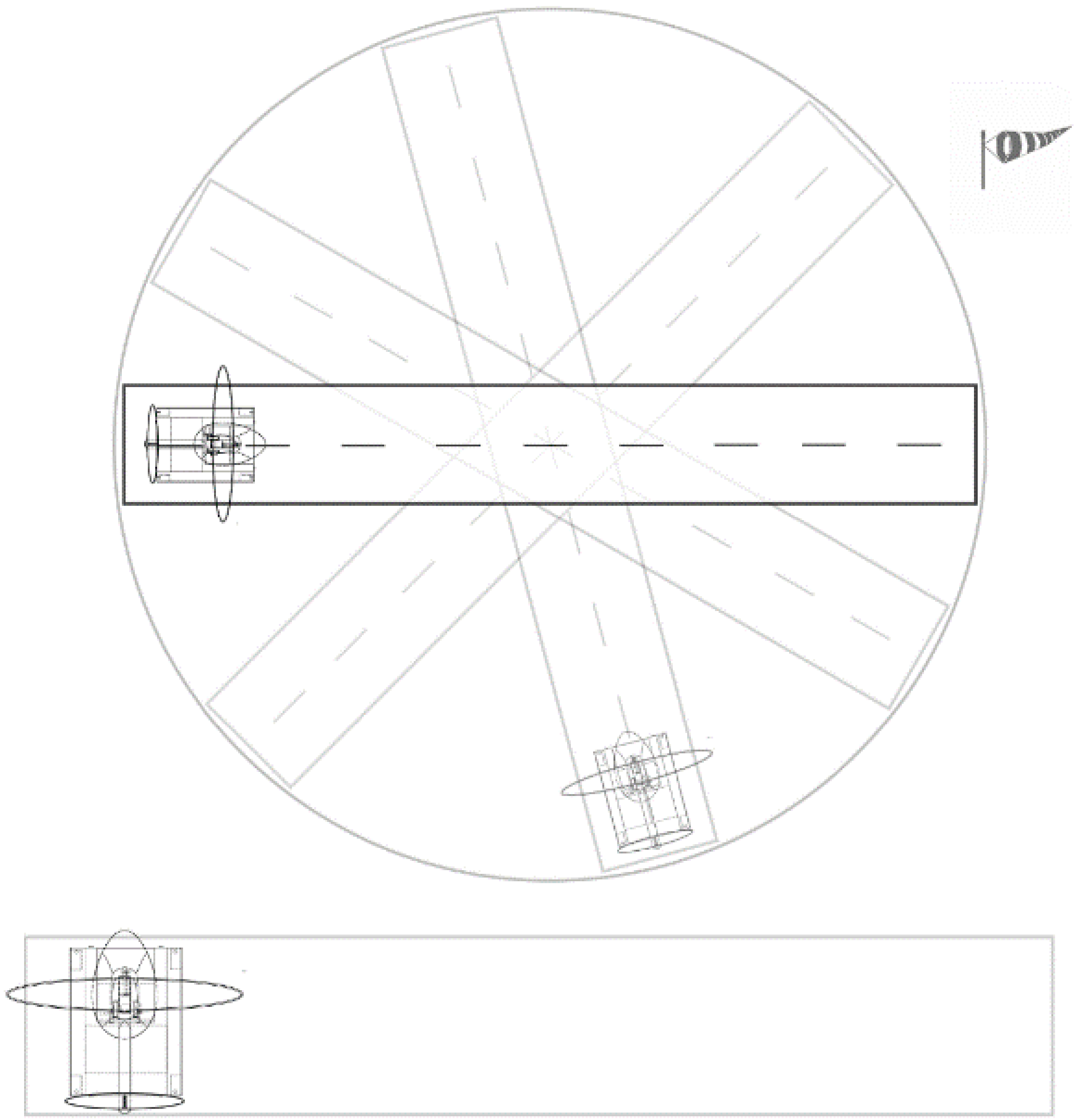


Fig. 6

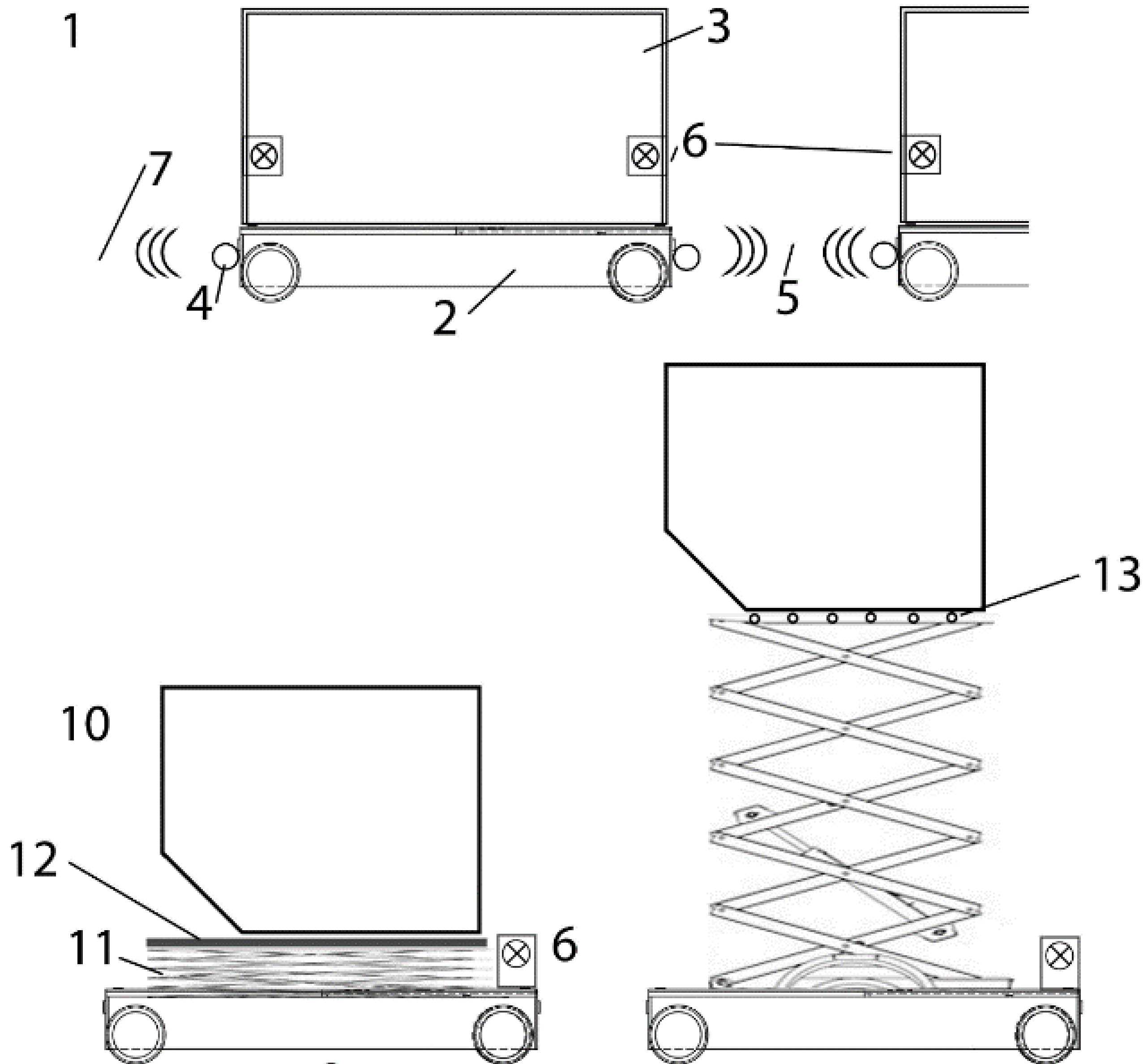



Fig. 7

1886

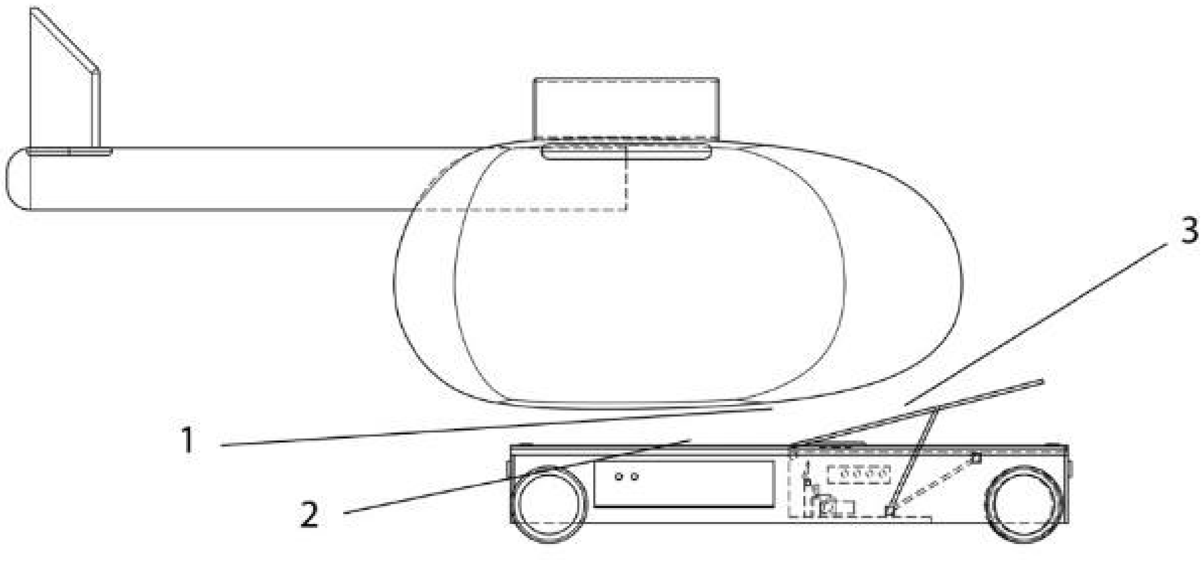



Fig. 8

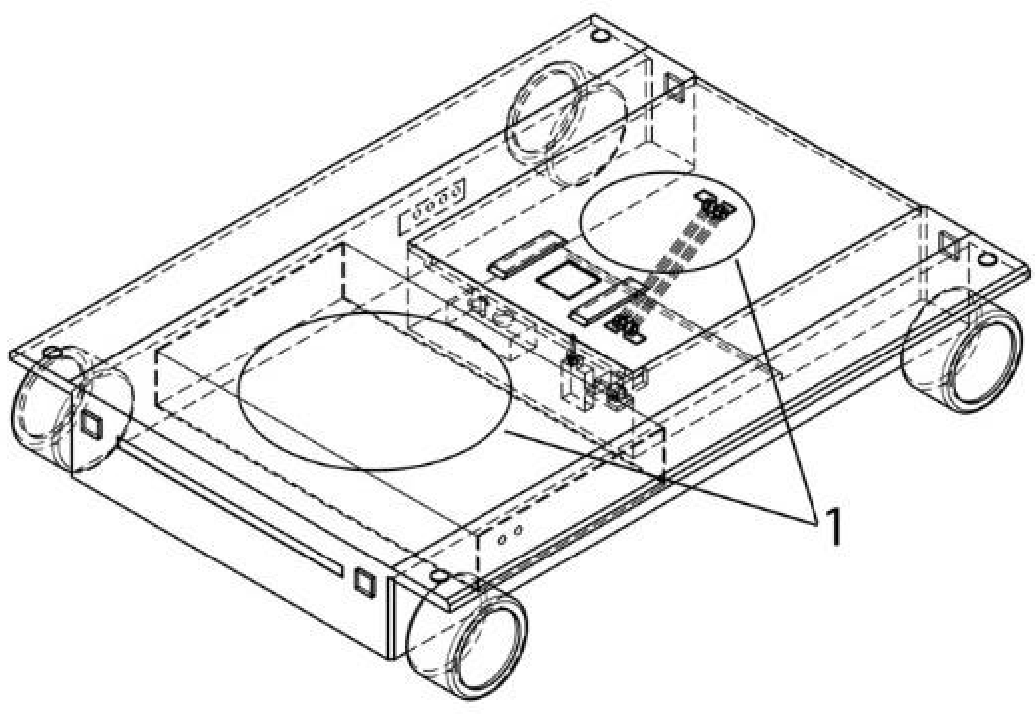



Fig. 9

Fig 10. A more detailed sequence for a craft using the platform and the airport

1 Craft approaches the airport area (jurisdiction).

2 Craft and airport communicates and exchange information*: where the craft is, intention, status of each other; at least some information is also transmitted by each to their respective central operation center – as check procedure failsafe procedure, each may repeat the information received from each other (as well as certain information from other crafts (if any) in the airport area, including of crafts of other service providers) to their operation centers. Some information and communication can be done while the craft in still on the flight and approaching the airport area or the craft has entered the airport area and has stopped.

Additionally and optionally, at each appropriate waypoint the craft can communicate to the airport and to its central operation center – its various information and data, status (passengers to load or offload, ETA, etc.)

*Information exchange/processed include:

- By Craft: Passengers to get off or received request to board; if craft is on-time or not; its preferred departure time from the airport; if craft wants to wait at the airport until some future event or instruction from airport or its central operation.
- By Airport: If other crafts are in the airport and in the airspaces 'near' the airport; their position/momentum, intentions, etc.; if passengers have requested to the airport to board the subject craft.
- Each may also wait for instructions from respective operation centers – e.g., the airport* may have instructions that may override both its and that of the crafts (e.g., report of an accident in the road up ahead and for all crafts to remain at the airport). *The airport is generally assumed to house its operation center, however and depending on the level of automation, there can be a greater regional operation center for the airport and that some of the command, control and communication system for the airport will be controlled by the regional operation center.
- Rules are obeyed by the craft and airport based on the protocols set and agreed to by respective systems (crafts (where one service provider may have priority over another, etc.), their service providers, the airport, their respective operation centers); and these govern for each decision points while in the airport. Exceptions are that some 'master' control can be given and made available for ground crews (the human station master) to override any system, instructions or control by the respective systems.

3 Craft communicates intent to, such as: to load/unload passengers at the airport; to recharge/swap batteries; or to land and wait at the airport; etc.

4 Craft and airport runs (if not already done) procedures, sub-routines to see if other event or crafts are at asking to land, etc. Additionally, they discuss the weather and wind conditions at the approach and landing – e.g., if conditions are within the parameters to land on the platform or if 'too windy' then to cancel the platform and to land directly on the tarmac; etc.

5 Decision is made to land on the platform.

6 Airport gives landing protocols and instructions; any event/instructions overriding the landing? Yes/No/Wait for further instructions/Are there other crafts present and are they occupying the approach space, etc.

7a If Yes to landing: Airport gives landing protocols and instructions; the identification of the platform; the platform's status; and if not already stored in the craft's memory, the platform operation information, access to platform command and control protocols; the platform moves to area (if not there already) to prepare to be instructed by the craft; the craft takes over the control over the platform and its movement controls.

7b If No to landing, some instructions or routines can be: Craft is instructed to delay landing; go into a holding pattern; etc.

8 The craft instructs the platform to move/accelerate to be in tandem with the landing speed and momentum of the craft; all the while an 'abort the platform' routine is running to see if the craft ought to land directly on the tarmac and instruct platform to move out of way, etc.

9 Craft lands on the platform* or the raised bed (if such bed is provided, and the bed is lowered); the craft instructs the platform and airport that it has landed well; and the craft's engines shut down. *There can be flaps or other means in the platform which can rise up to help arrest the front wheel from forward motion after the craft has landed.

10 The airport or the platform takes control over the platform and move the platform to the designated docking area.

11 The passengers/pods are loaded/boarded. Meanwhile, routines are running for next actions of the craft or the airport (last minute passenger request), if to delay taxiing, etc.

12 If to depart, the platform moves to the runway area; the craft take over the control over the platform and instructs its acceleration speed; raising of the nose (if desired); for the active noise cancelling system to turn on; etc.

13 The craft may make its own minute adjustments to the propulsion system, its flaps, and begins to lift off the platform.

14 Craft takes flight, leaves the airport area, enters the general airspace and operates autonomously and in communication with its operation center, and either can communicate its ETA and current (pending status, intent) to the next station.

15 ‘All’ events, ‘performance’, movement data of the craft, other crafts, passengers load/unload, time of arrival/departure, any aberrations, nears misses, performance range within/out-of the constraints/safety-parameters for each routine, weather conditions, traffic, conditions of airport (potholes – using motion sensors on the platform), etc. are stored, scored, flagged by respective systems.

Fig 11 - Methods and system for autonomous driverless public vehicles at stations, bus stops

1 Vehicle approaches the station area (jurisdiction).

2 Vehicle and station communicates and exchange information: where the vehicle is, intention, status of each other; at least some information is also transmitted by each to their respective central operation center – as check procedure failsafe procedure, each may repeat the information received from each other (as well as certain information from other vehicles (if any) in the station area, including of vehicles of other service providers) to their operation centers. Some information and communication can be done while the vehicle in still on the road and approaching the station area or the vehicle has entered the station area and has stopped.

Information exchange/processed include:

- By Vehicle: Passengers to get off or received request to board; if vehicle is on-time or not; vehicle wants to wait at the station until some future event or instruction from station or its central operation.
- By Station: If other vehicles are in the station, their position/momentum, intentions, etc.; if passengers have requested to the station to board the vehicle.
- Each may also wait for instructions from respective operation centers – e.g., the station may have instructions that may override both its and that of the vehicles (e.g., report of an accident in the road up ahead and for all vehicles to remain at the station).
- Rules are obeyed by each based on the protocols set and agreed to by respective systems (vehicles (where one service provider may have priority over another, etc.), their service providers, the station, their respective operation centers); and these govern for each decision points while in the station.

3 Vehicle communicates intent to load passengers.

4 Vehicle and station runs (if not already done) procedures, sub-routines to see if other event or vehicles are at the station, etc.

5 Vehicle communicates intent/desire to load passengers at the station.

6 Station: Any event/instructions overriding the loading of passengers? Yes/No/Wait for further instructions/Are there other vehicles present and are they occupying the loading zone/ etc.

7a If Yes: Vehicle receives instructions to load passengers – and either the vehicle or the station operates the movement controls and systems of the vehicle; and to load the passengers.

7b If No, some instructions or routines can be: Vehicle is instructed to move to a wait area, or to remain where it is;

Also could be to 'wait' and remain at the current spot; and station moves/instructs other vehicles (to) move 'out of the way'.

8 Passengers are loaded/boarded. Meanwhile, routines are running for next actions of the vehicle or the station (last minute passenger request), etc.

9 Passengers are loaded/boarded; vehicle and station each runs systems to move away from the loading area and to proceed out of the station; this may include for each to see* what is going on the area or road immediately outside of the station area (approaching vehicles, congestion, accident reports, etc.). *This can include third party information/reporting systems such as traffic status from Google Maps and the Waze application. And as appropriate such information is communicated to the passengers by displays in the vehicles or to their smartphone app.

Move: Yes/No/Wait

10 If Yes, the vehicle or the station moves the vehicle to edge of the station zone, and then the vehicle takes over to move out of the zone and enter the public road.

11 Vehicle enters the public road and operates autonomously and in communication with its operation center, and either can communicate its ETA and current (pending status, intent) to the next station.

12 'All' events, 'performance', movement data of the vehicle, other vehicles, passengers load/unload, time of arrival/departure, any aberrations, nears misses, performance range within/out-of the constraints/safety-parameters for each routines, weather conditions, traffic, conditions of the station (potholes – using motion sensors on the vehicles), etc. are stored, scored, flagged by respective systems.

Title: Out of band authenticating cryptographic memory storage device.

Inventors: Michael Chung. John Sokol

Figures 100, 200, 300

Fig 100 has descriptions, components, methods, systems and embodiments.

Fig 100

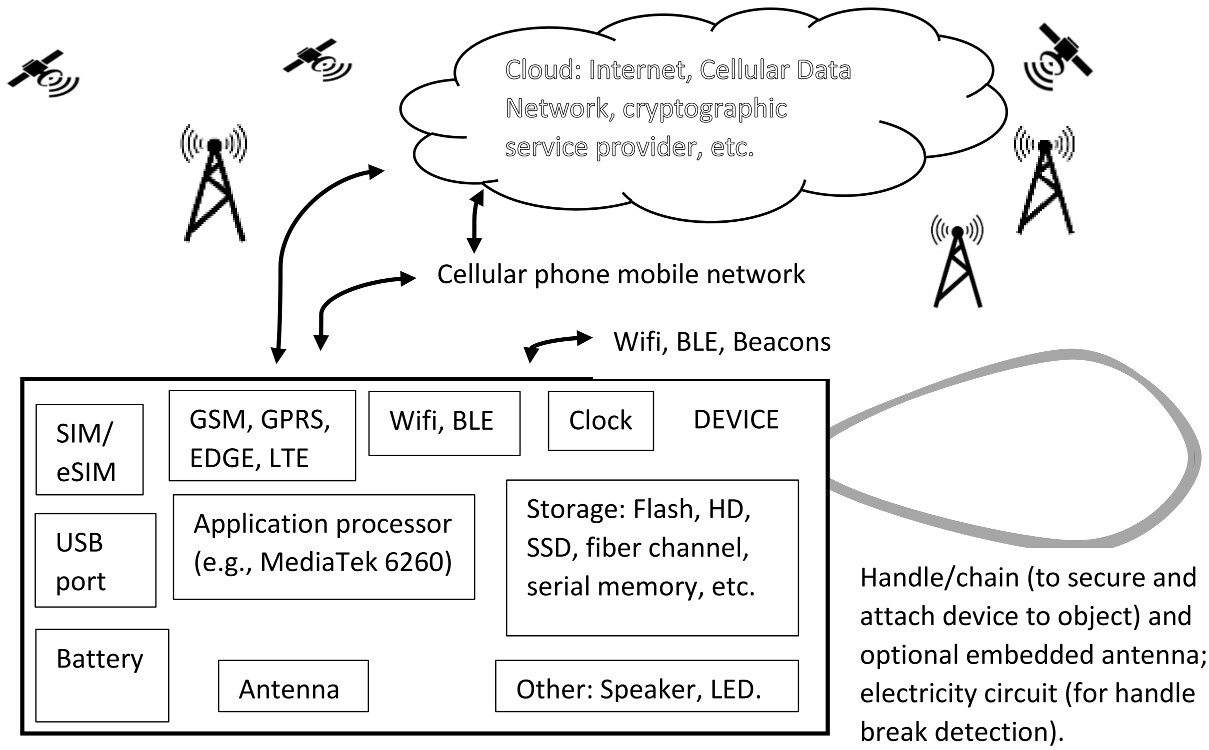



Fig 200 has the basics of the authentication process

Figure 200

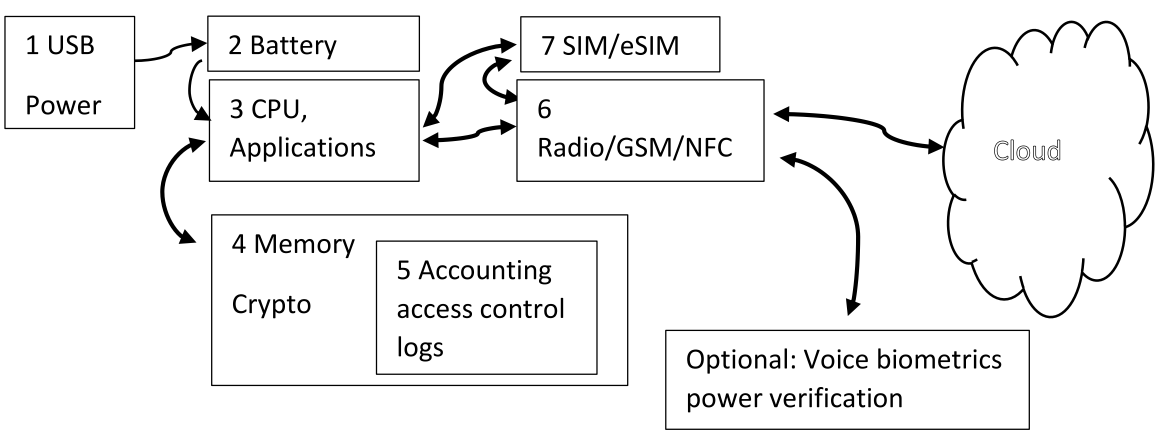


Figure 300 – One embodiment and user process

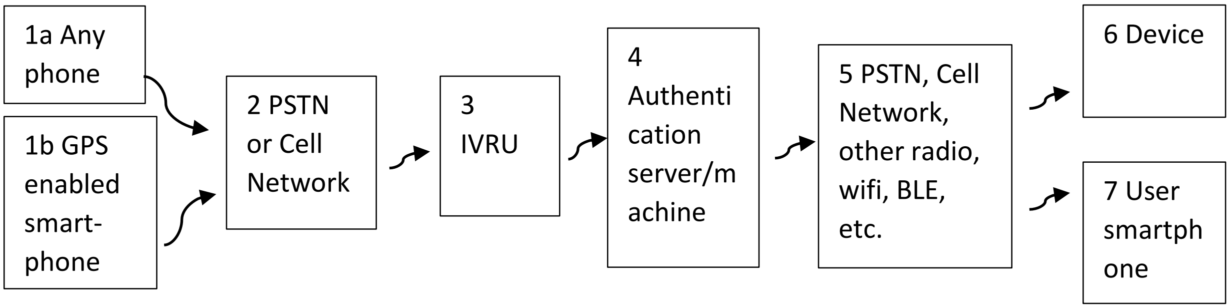
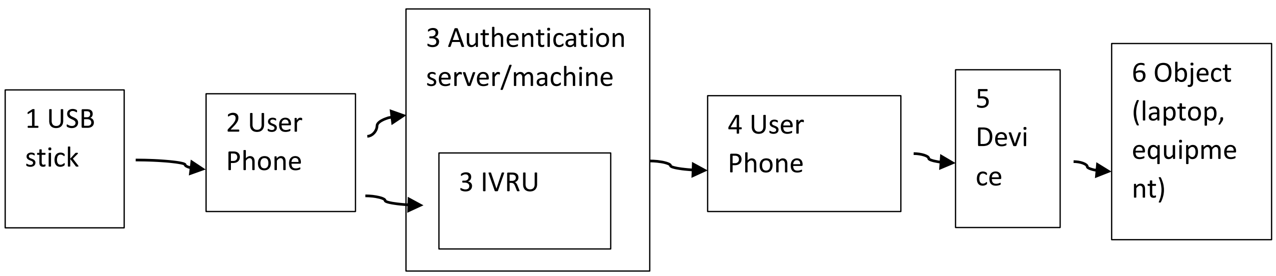



Figure 400 – One embodiment and user process



Title: A method, system and apparatus, e.g. a smart-rack-storage for multiple tracking and location devices or sensors and to automatically provision and track services (e.g., data, communication).

Inventor: Michael Chung

Figures 100, 110

Fig 100

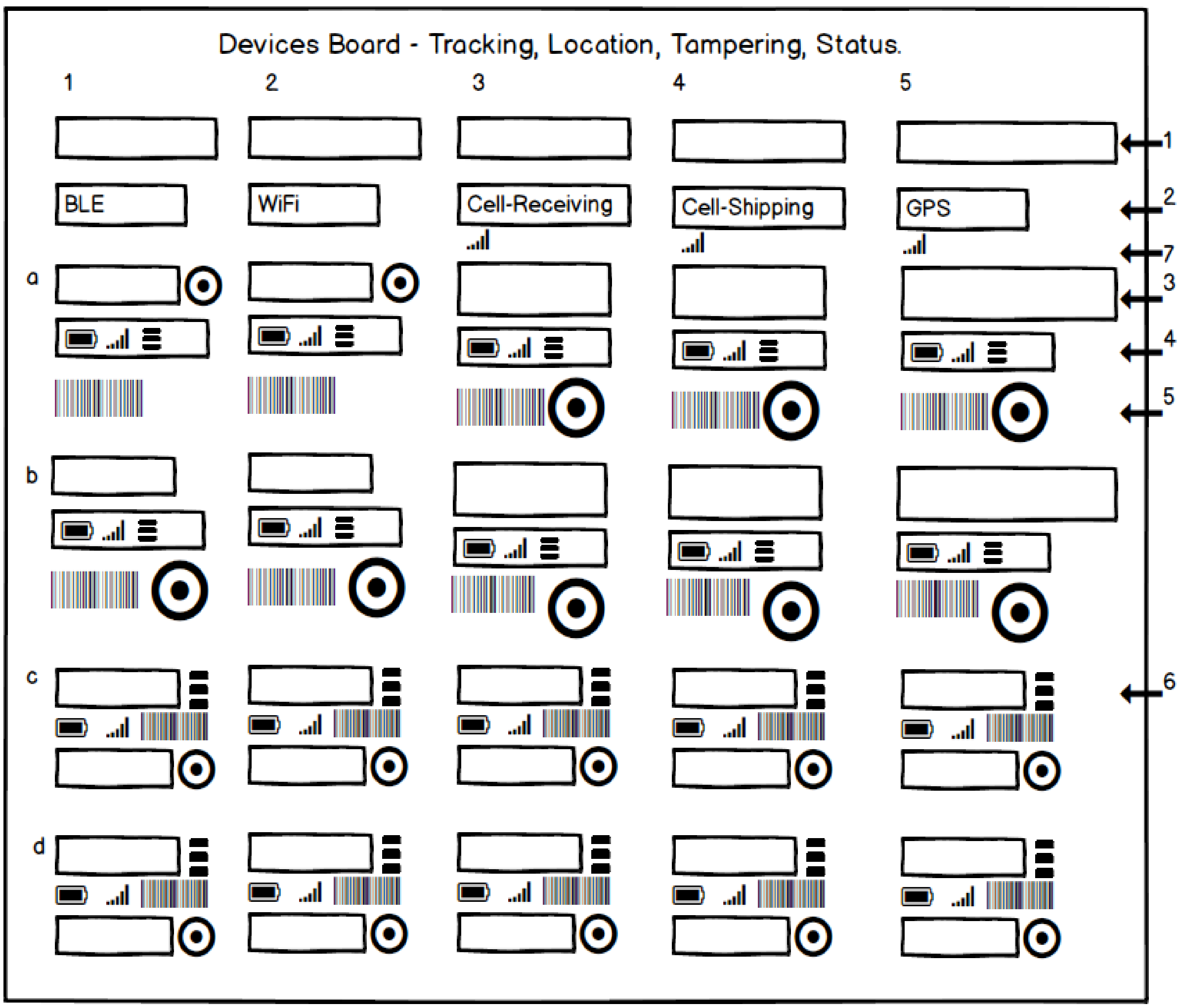
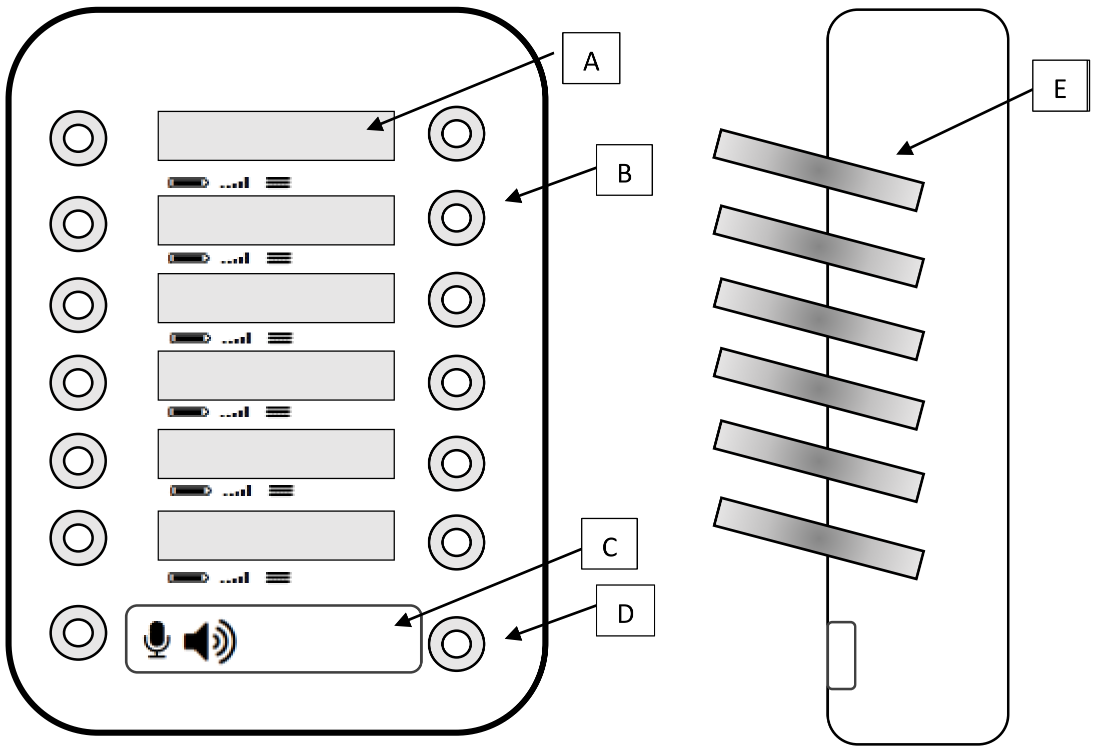


Fig 110 – Other embodiment for the rack – a ‘home use tag rack’.

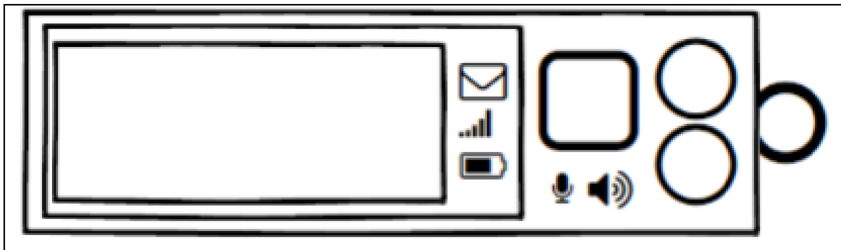


Title: A method, system and apparatus for - personal messaging devices - using messaging and signaling devices and cellular network and cellular technology.

Inventor: Michael Chung

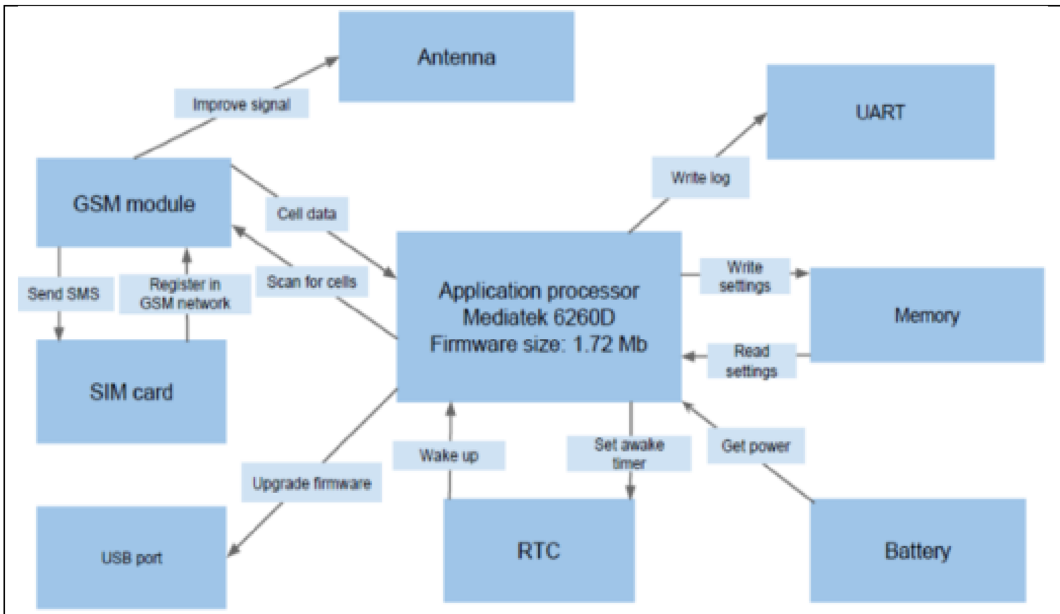
Figures 200, 210, 220

**Fig 200 – a 'message-lite 140 character' cellular (USSD) service device.**



Display for messages; message, signal, battery indicator; touch-sensitive control; microphone (for voice to text), speakers for sound, rings; 2 buttons for n functions; key chain hook.

Fig 210 – An earlier generation of module (image) for cellular based location and tracking service; with added description of the invention components and system to enable Fig 200:




A cycle for location – tracking, communication:
1-Device wakes up
2-Registration in network 3-Scanning for available cells (for location, at least 3, information stored in memory)
4-Sending/receiving data over BCCH/USSD
5-Optional – go to sleep until next wake up time (to save battery).

Fig 220. A Sequence for one to many communication:

Device A user enters and pushes the user selected/created text (entered via text pad, voice to text, or from a pre-stored selection visible on the device's display) using an app, WAP.

Device additionally sends (based on configuration, and instructions in its memory) its location and/or other general or specific information (which can be used by one or all of the following). The service provider's protocols are used for the messages and communication.

Message sent to Cell operator; or Wifi to the Rack (then Rack to the cell operator).

Cell operator forwards/copies message to the Device's service provider/server (USSD is not a store and forward intrinsically); optionally waits for authorization to forward the message (functions at service provider include: recipient lookup; authentication of sender; etc.; encryption/ decryption (if being used); reviewing the status data sent by the sending Device (e.g., its geolocation, etc.) then pushing/authorizing send of the message/instruction to the recipients' devices.

To Cell towers (if cellular service); if the devices are local network then wifi to the Rack' etc.

To Devices B and/or C – the text is displayed; a LED lights up; a sound is made.

To Devices B and/or C – sends delivery confirmation back to Service provider.