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BEFORE THE PATENT TRIAL AND APPEAL BOARD

DJI EUROPE B.V.
Petitioner,

v.

TEXTRON INNOVATIONS INC.
Patent Owner

IPR2023-01227

U.S. Patent 11,288,972

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT 11,288,972**

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EXHIBIT LIST

Exhibit	Description
DJI-1001	U.S. Patent 11,288,972 to Bristow et al. (“’972 patent”)
DJI-1002	’972 patent file history
DJI-1003	Declaration of Charles F. Reinholtz, Ph.D. in support of Petition for <i>Inter Partes</i> Review
DJI-1004	Curriculum Vitae of Charles F. Reinholtz, Ph.D.
DJI-1005	Homola et al., “UTM and D-NET: NASA and JAXA’s Collaborative Research on Integrating Small UAS with Disaster Response Efforts” (“UTM-DNET”), available at https://ntrs.nasa.gov/api/citations/20180004805/downloads/20180004805.pdf
DJI-1006	U.S. Patent 9,852,642 to Butler et al. (“Butler”)
DJI-1007	U.S. Patent 9,658,619 to Bethke et al. (“Bethke”)
DJI-1008	Declaration of Trenton J. Roche regarding UTM-DNET
DJI-1009	NASA Technical Reports Server Record Details for UTM-DNET, available at https://ntrs.nasa.gov/citations/20180004805
DJI-1010	2018 Aviation Technology, Integration, and Operations Conference Table of Contents, available at https://arc.aiaa.org/doi/book/10.2514/MATIO18
DJI-1011	AIAA details for UTM-DNET (AIAA 2018-3987), available at https://doi.org/10.2514/6.2018-3987
DJI-1012	U.S. Patent App. Pub. 2015/0234387 to Mullan et al.
DJI-1013	Exhibit D to Plaintiff Textron Innovations Inc.’s P.R. 3-1 and 3-2 Disclosure of Asserted Claims, Infringement Contentions, and Document Production, <i>Textron Innovations Inc. v. SZ DJI Tech. Co., Ltd.</i> , Civil Action No. 2:22-cv-00351 (E.D. Tex. Sept. 9, 2022)
DJI-1014	Kopardekar et al., “Unmanned Aerial System (UAS) Traffic Management (UTM): Enabling Low-Altitude Airspace and UAS Operations,” available at https://ntrs.nasa.gov/api/citations/20140013436/downloads/20140013436.pdf

Exhibit	Description
DJI-1015	NASA Facts. “UTM: Air Traffic Management for Low-Altitude Drones” (2015), <i>available at</i> https://www.nasa.gov/sites/default/files/atoms/files/utm-factsheet-02-23-16.pdf
DJI-1016	Rios et al., “UTM Data Working Group Demonstration 1 Final Report” (April 2017), <i>available at</i> https://ntrs.nasa.gov/api/citations/20170010270/downloads/20170010270.pdf
DJI-1017	Rios et al., “Unmanned Aircraft Systems Traffic Management (UTM) Concepts and Architecture Overview” (March 2018), <i>available at</i> https://ntrs.nasa.gov/api/citations/20180001929/downloads/20180001929.pdf
DJI-1018	Kopardekar et al., “Unmanned Aircraft System Traffic Management (UTM) Concept of Operations” (June 2016), <i>available at</i> https://ntrs.nasa.gov/api/citations/20190000370/downloads/20190000370.pdf
DJI-1019	RESERVED
DJI-1020	RESERVED
DJI-1021	RESERVED
DJI-1022	RESERVED
DJI-1023	RESERVED
DJI-1024	RESERVED
DJI-1025	Jiang et al., <i>Unmanned Aircraft System traffic management: Concept of operation and system architecture</i> , International Journal of Transportation Science and Technology, 5.3, pp. 123-35 (2016)
DJI-1026	RESERVED
DJI-1027	“Unmanned Aircraft System Traffic Management (UTM) Research Transition Team Concept Working Group, Concept & Use Cases Package #2: Technical Capability Level 3, Version 1.0” (March 2018), <i>available at</i> https://ntrs.nasa.gov/api/citations/20190004908/downloads/20190004908.pdf .
DJI-1028	“Enabling Civilian Low-Altitude Airspace and Unmanned Aerial System (UAS) Operations by UTM” (March 23, 2015), <i>available</i>

Exhibit	Description
	at https://ntrs.nasa.gov/api/citations/20160000434/downloads/20160000434.pdf .
DJI-1029	“Safely Enabling Low-Altitude Airspace Operations” (June 23, 2015), <i>available at</i> https://ntrs.nasa.gov/api/citations/20150018862/downloads/20150018862.pdf .
DJI-1030	U.S. Patent App. Pub. 2016/0275801 to Kopardekar
DJI-1031	Webster’s New World Dictionary of Computer Terms (8 th edition) (excerpt)
DJI-1032	Chinese Patent App. Pub. CN 105334863 to Yang

I. Introduction

DJI Europe B.V. (“Petitioner”) petitions for *inter partes* review (“IPR”) of claims 1-20 of U.S. Patent 11,288,972 (the “’972 patent”; DJI-1001). The claims recite basic techniques for planning, controlling, and monitoring autonomous unmanned aircraft system (“UAS”) operations. These techniques were well-known before the ’972 patent’s effective filing date.

II. Grounds for Standing

Petitioner certifies the ’972 patent is available for IPR, and that Petitioner is not barred or estopped from requesting IPR.

III. Identification of Challenge

A. Prior Art

The ’972 patent was filed on December 19, 2019. Each of the applied references listed below was described in a publication issued or effectively filed before December 19, 2019.

1. **Homola, et al., “UTM and D-NET: NASA and JAXA’s Collaborative Research on Integrating Small UAS with Disaster Response Efforts”** (“UTM-DNET”; DJI-1005) is prior art under 35 U.S.C. §102(a)(1) because it was described in a printed publication and available to the public before the effective filing date of the ’972 patent. UTM-DNET was at least publicly available on NASA’s Technical Reports Server (“NTRS”) since September 25, 2018. (DJI-1008, ¶¶3-5.) NTRS “is free and publicly accessible, contains record

details for all of the published materials, and is publicly searchable by keyword.”

(DJI-1008, ¶3.) UTM-DNET is listed in NTRS as Document ID 20180004805.

(DJI-1008, ¶¶4-5; DJI-1007.) The record details on NTRS indicate that UTM-DNET is a conference paper originally presented at the 2018 American Institute of Aeronautics and Astronautics (“AIAA”) Aviation Technology, Integration, and Operations Conference held in Atlanta, Georgia and is a public document without distribution limits. (DJI-1009.) The AIAA website indicates that UTM-DNET was presented as part of the Advanced Operational Concepts session on June 28, 2018 at 1600 hrs (4:00pm). (DJI-1010, 74; DJI-1011, 1.)

2. **U.S. Patent 9,852,642 to Butler et al.** (“Butler”; DJI-1006), filed on March 8, 2016, and issued on December 26, 2017, is prior art under 35 U.S.C. §102(a)(2).

3. **U.S. Patent 9,658,619 to Bethke et al.** (“Bethke”; DJI-1007), filed on April 18, 2016, and issued on May 23, 2017, is prior art under 35 U.S.C. §102(a)(2).

None of the applied references were cited in or discussed during prosecution of the ’972 patent, weighing heavily against discretionary denial under 35 U.S.C. §325(d). (*See* DJI-1001, (56).)

B. Grounds for Challenge

Ground 1: Claims 1-5, 7-12, 14-18, and 20 are obvious over UTM-DNET and Butler.

Ground 2: Claims 6, 13, and 19 are obvious over UTM-DNET, Butler, and Bethke.

IV. Background

A. Technology Background

Sophisticated systems and methods for managing fleets of unmanned aircraft systems (“UASs”) were well known long before the ’972 patent’s December 2019 filing date. (See DJI-1003, ¶¶26-44.) For example, in 2012, amidst rapidly increasing adoption of UASs for various commercial, recreational, and industrial applications, Congress enacted the FAA Modernization and Reform Act, which mandated the creation of a plan to safely integrate civilian UASs into the National Airspace System (“NAS”) by September 2015. (DJI-1025, 124.) And in 2013, NASA began development of the UAS Traffic Management (“UTM”) System, an air traffic control system for managing the growing number of UASs in the NAS. (DJI-1016, 3.) NASA’s goal for UTM was to essentially combine automobile traffic management with air traffic control. NASA’s UTM System thus built upon years of research in the fields of automobile congestion management, manned airspace management, and UAS control.

The NASA UTM System is described in a set of documents published and publicly available on NASA's NTRS. (See DJI-1008, ¶3.) For example, the below figure from a 2014 NASA Technical Manual illustrates a functional description of NASA's UTM System and demonstrates its breadth. (DJI-1014, 4.) Inputs to the UTM system include the elements shaded in green (e.g., airspace constraints, weather/wind data). The right side of the center box lists UTM's functions (e.g., constraint management, trajectory changes). The left side of the center box highlights the importance of "autonomicity ... [and] related automation" within the UTM system.

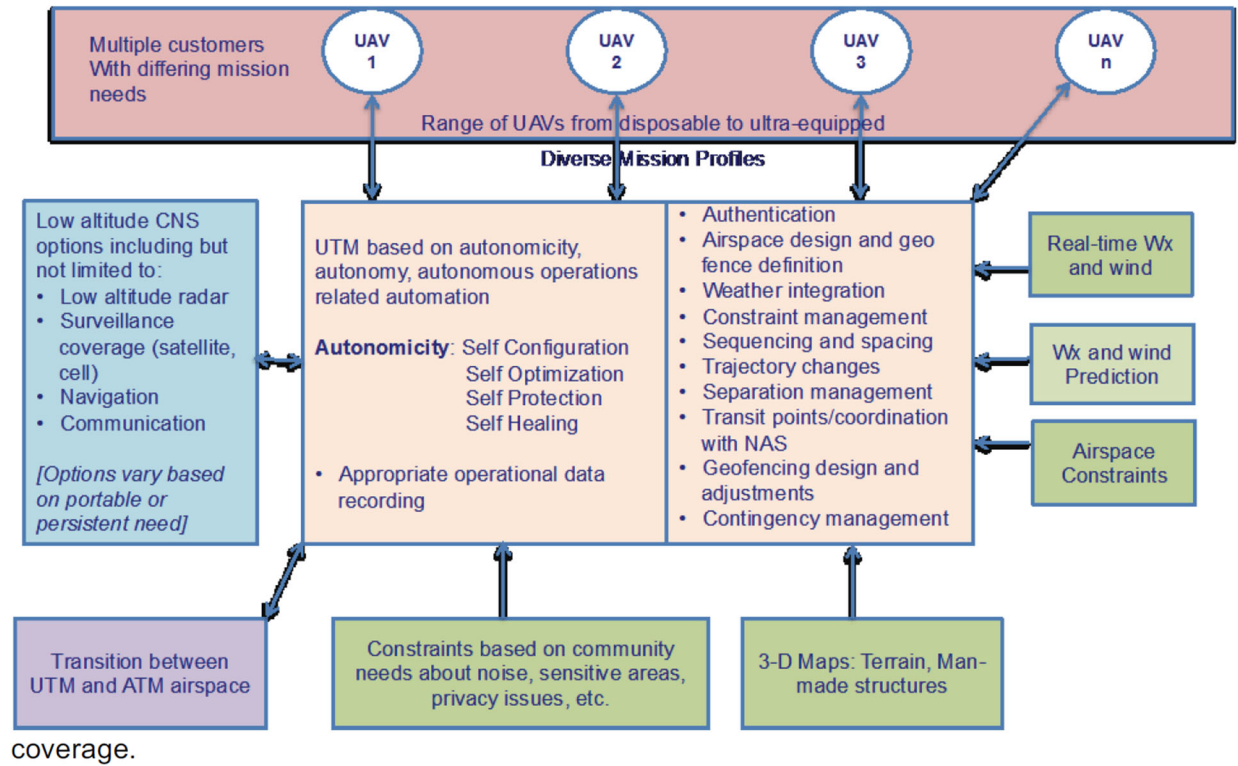


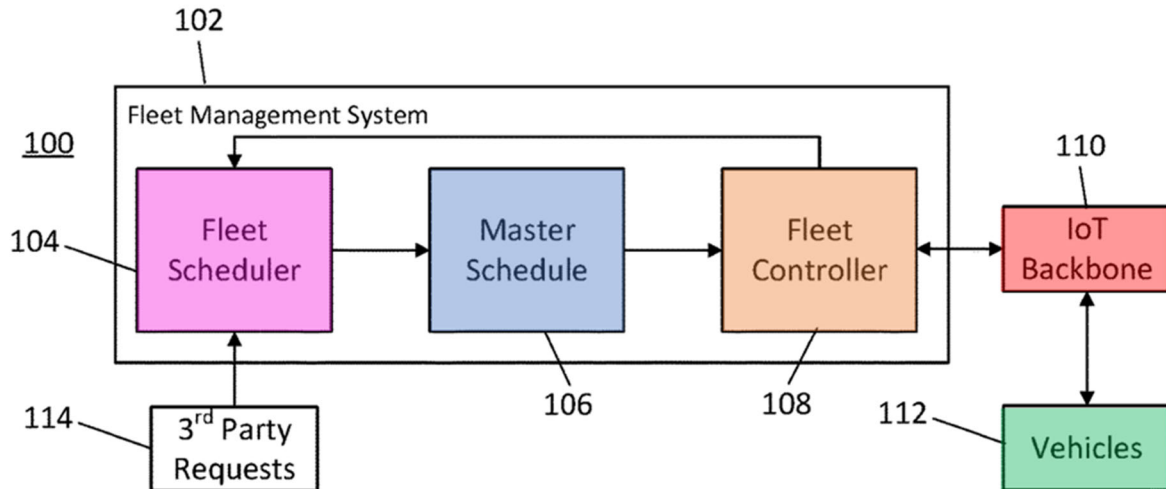
Figure 1: Example Functional Description of UTM

DJI-1014, Figure 1.

B. The '972 Patent

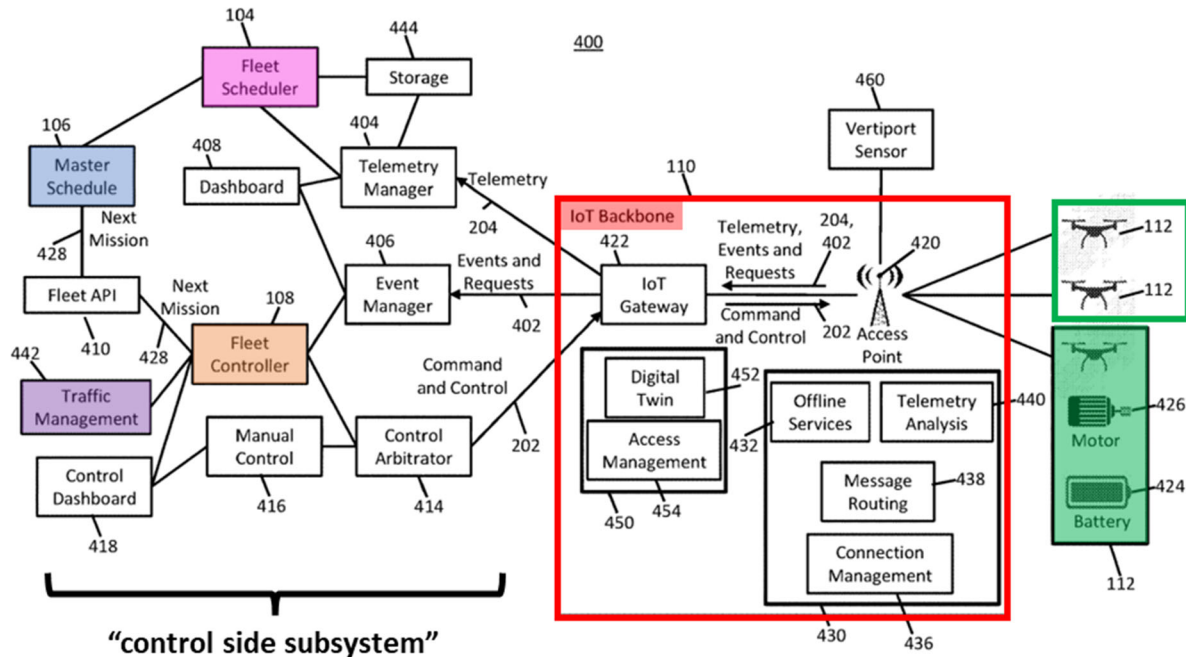
The '972 patent relates generally to “scheduling and controlling individual autonomous vehicles in a fleet.” (DJI-1001, 1:5-7.) The fleet management system 102, illustrated in annotated Figure 1 below, includes “a fleet scheduler 104 [shaded pink] that generates, or submits entries to, a master schedule 106 [shaded blue].” (DJI-1001, 3:21-23.) Master schedule 106 “is used by a fleet controller 108 [shaded orange] to control one or more vehicles [shaded green] through a communications system such as an internet-of-things (IoT) backbone 110 [shaded

red].” (DJI-1001, 3:23-26.) Vehicles 112 “feed operational data back through the IoT backbone 110, which then delivers the operational data back to the fleet scheduler 104.” (DJI-1001, 3:26-30.)



’972 patent, Figure 1 (annotated).

Annotated Figure 4 below illustrates operation of the fleet management system 400. IoT backbone 110 (outlined in red) connects vehicles 112 (outlined and shaded in green) to a “control side subsystem” that includes fleet scheduler 104 (shaded pink), master schedule 106 (shaded blue), fleet controller 108 (shaded orange), and traffic management system 442 (shaded purple). (DJI-1001, 6:25-32, 8:50-59.)



'972 patent, Fig. 4 (annotated).

In operation, fleet controller 108 generates a flight path and checks its availability using data from traffic management system 442 related to, for example, traffic, airspace restrictions, or weather. (DJI-1001, 8:64-9:4, 10:16-18, 10:21-23.) During performance of a mission, vehicles 112 transmit operational parameters (e.g., location, altitude, airspeed) and event data through IoT backbone 110 to the control side subsystem for use in tracking, controlling, and verifying the location of vehicles 112. (DJI-1001, 6:53-7:8, 8:17-22, 8:26-43.)

C. Level of Ordinary Skill in the Art

A person having ordinary skill in the art ("POSITA") at the time of the alleged invention of the challenged claims would have had at least a bachelor's degree or equivalent in the field of aeronautical engineering, electrical engineering,

mechanical engineering, computer science, or equivalent training and experience, and at least one year of experience in the field of unmanned vehicles. A higher level of education or work experience might make up for less experience, and vice versa. (DJI-1003, ¶¶48-49.)

D. Prosecution History

The '972 application was filed with three independent claims¹ having substantially overlapping subject matter. Representative claim 1 is reproduced below:

A method, comprising:

- obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule;
- generating vehicle commands according to mission parameters associated with the mission;
- maintaining a persistent connection with the vehicle;
- sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and
- monitoring operation of the vehicle during performance of the mission.

¹ The three originally filed independent claims correspond to issued independent claims 1, 8, and 15.

(DJI-1002, 27.) The Examiner rejected all originally filed claims, including the independent claims, as anticipated based on U.S. Patent Publication 2015/0234387 to Mullan et al. (“Mullan”; DJI-1012). (DJI-1002, 176-90.) Of note, the Examiner found that a collection of work orders related to UV missions met the “master schedule” limitation of the claim:

obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule; (Mullan paragraph 0023 discloses, “The fleet and mission operations controller may receive a work order related to UV mission. According to an example, work orders may be received from various enterprises and cover a variety of applications of UVs. The fleet and mission operations controller may operate in conjunction with the mission manager to translate a work order into a mission request. ...”)

(DJI-1002, 176.)

Applicant did not rebut the Examiner’s rejection of the independent claims but instead amended the independent claims to recite limitations disclosed in dependent claims 2, 9, and 16, which were cancelled: (1) identifying a flight path associated with the mission; (2) verifying a usability of the flight path with a UTM; and (3) modifying the flight path using data from the UTM. (DJI-1002, 207-14.) Applicant argued that although Mullan disclosed “verifying the mission’s

compliance with government regulations and policies,”² Mullan failed to disclose “check[ing] for ‘traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path’ or ‘modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified.’” (DJI-1002, 210-15.) Based on these amendments, the Examiner subsequently allowed the claims. (DJI-1002, 278-80.)

However, identifying a flight path, verifying the usability of that flight path with a UTM, and modifying the flight path based on the verification response is exactly what is disclosed by UTM-DNET.

E. Claim Construction

Claim terms are typically given their ordinary and customary meanings as understood by a POSITA at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-16 (Fed. Cir. 2005) (en banc). Petitioner does not believe it is necessary for the Board to expressly construe any term for the purpose of this IPR proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

² All emphasis added unless otherwise noted.

V. Ground 1: Claims 1-5, 7-12, 14-18, and 20 are Obvious Over the Combination of UTM-DNET and Butler.

A. Overview of the Combination

1. UTM-DNET

UTM-DNET is a joint 2018 paper by NASA and JAXA (“Japan Aerospace Exploration Agency”) that describes the integration of JAXA’s D-NET, “a portable system for aircraft operation management in the immediate aftermath of a large disaster,” with NASA’s UTM, “which provides airspace management to enable large-scale high density operations.” (DJI-1005, 1, 3.)

UTM-DNET explains that “aircraft play a major role in disaster recovery, since damaged infrastructure often hinders the access to disaster-hit areas.” (DJI-1005, 2.) In Japan, disaster relief operation centers “manage aircraft operations in immediate post-disaster relief.” (DJI-1005, 2.) Dispatchers in these centers “oversee operations of multiple aircraft and coordinate with the disaster relief forces.” (DJI-1005, 2.) The aircraft “are involved in various missions, such as general reconnaissance, search, rescue, and transportation of personnel and goods.” (DJI-1005, 2.) “When the disaster is not spread over a large area, the number of vehicles involved allows the dispatchers to allocate the most appropriate mission to each vehicle and follow the mission progress, but as soon as the scale of the disaster grows, human controllers need a decision support system to allocate the

available resources safely and optimally.” (DJI-1005, 2.) D-NET was developed to address this need.

a. D-NET

D-NET’s objective “is to acquire data efficiently from multiple sources such as satellites, helicopters, and unmanned aircraft systems to enable the analysis of these data in order to provide an optimal resource allocation and flight trajectory plan(s).” (DJI-1005, 3.) These plans are then “integrated into actual rescue operations.” (DJI-1005, 3.)

The D-NET system, illustrated in exemplary operations Figure 1 below, “has three main blocks: 1) data/information acquisition block, 2) optimal planning block and 3) operation execution block.” (DJI-1005, 3.) The D-NET system “optimizes the performance” of vehicles, including manned aircraft and unmanned aircraft, “by assigning missions according to the vehicle’s equipage, state, and location.” (DJI-1005, 3.) For example, “D-NET plans and assigns data acquisition missions to UAS in order to spare resources from the manned aircraft fleet so that more helicopters can be assigned to rescue missions.” (DJI-1005, 3.)

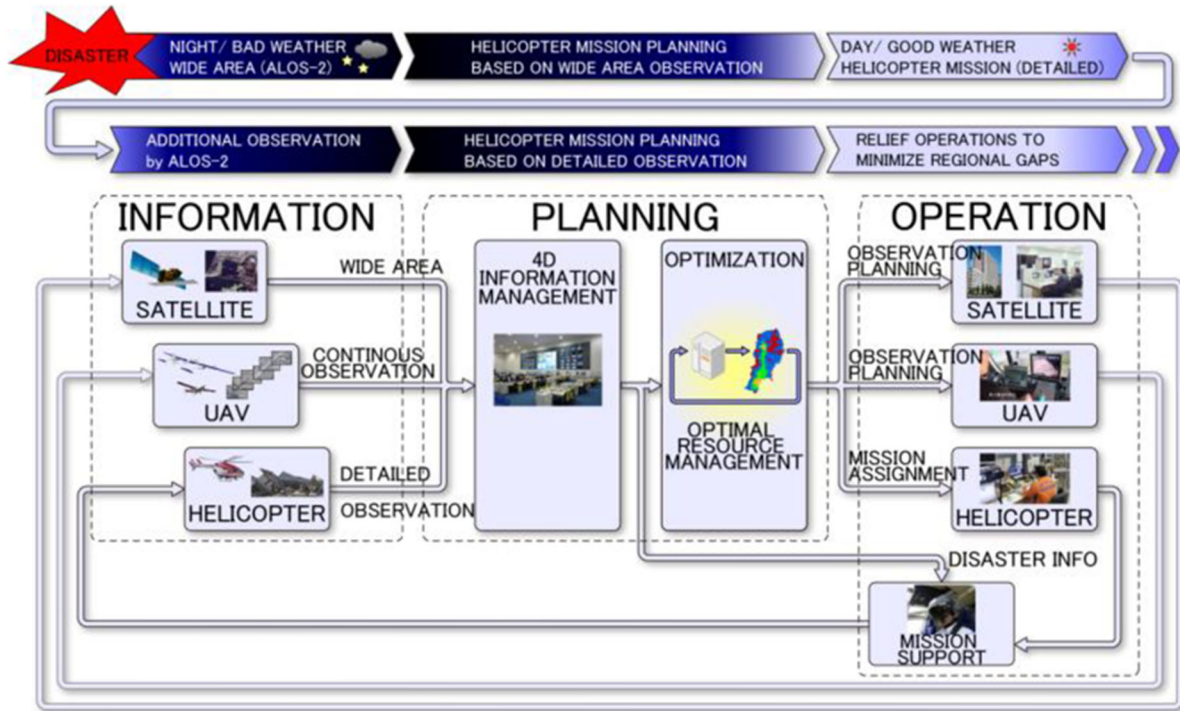


Fig. 1 D-NET operations.

UTM-DNET explains that for “large-scale disasters, hundreds of aircraft are deployed and engaged in search and rescue missions.” (DJI-1005, 3.) “Therefore, the overall coordination and integration of all aircraft are just as important, if not more, as the individual performance of any single vehicle.” (DJI-1005, 3.)

b. Unmanned Aircraft System (UAS) Traffic Management (UTM)

In response to the demand growth for commercial application of small UAS (sUAS), NASA embarked on “research to explore and define the concept, technologies, and guidelines necessary to provide a safe, scalable, efficient, and equitable approach to UAS traffic management.” (DJI-1005, 4.) Through this research, a scalable architecture was developed “to incorporate high levels of

automation” to manage traffic and provide separation services. (DJI-1005, 4; Figure 2 below.) The UTM system architecture includes a UAS Service Supplier (USS) which “facilitates communication between the different components and operators in the ecosystem, supports operation planning, assists in strategic deconfliction and airspace management, and is a source of operational information for its operators and other service providers.” (DJI-1005, 4.)

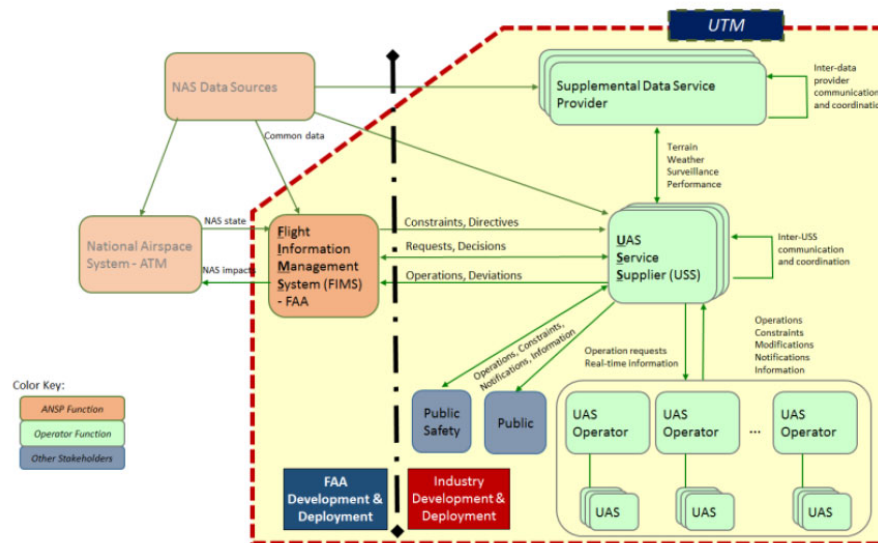


Fig. 2 Current architecture and information flow between major components of the UTM ecosystem.

A key part of the planning and deconfliction support provided by the USS is an Operation Volume “which is a 4-dimensional volume that consists of a single or multi-segmented 3-dimensional polygonal volume with a temporal component that represents the time and duration that the volume(s), as part of an operation, will be active within the UTM system.” (DJI-1005, 4.) An “Operation Volume serves to signal the intent of an operator to perform an operation and maintain the vehicle

within the bounds of the volume(s) at all times.” (DJI-1005, 4.) The USS “uses the Operation Volume for strategic deconfliction of airspace by checking proposed volumes from other operators within the same USS and from other USSs to ensure that there is no overlap in time and space of volumes.” (DJI-1005, 4.) This check “provides a level of assurance to the operator and potential airspace managers (e.g., in disaster response situations) that the operation can be performed with reduced concern of sharing the airspace with other vehicles at the same time.” (DJI-1005, 4-5.)



Fig. 4 Example of UAS flight plan (left) and associated Operation Volume (right)

UTM-DNET, Figure 4.

As shown above, “an operator first identifies an area for the flight and, depending on the intended operation, develops a flight plan for the vehicle” (left). (DJI-1005, 5.) For that plan “to be communicated to the UTM system, a polygonal volume or set of volume segments that encapsulates the developed flight plan or intended area of operations is constructed by the operator.” (DJI-1005, 5.) This

initial volume represents a 3D volume “of where an intended operation is to occur with an associated temporal component that defines the duration for when that volume or segment will be active.” (DJI-1005, 5.) The USS may add additional buffers to the initial volume to account for uncertainties. The final volume that is “accounted for within the USS and communicated to the USS network and supporting services – if present – is the Operation Volume.” (DJI-1005, 5.)

After generation of the Operation Volume, the USS then “checks on the airspace to ensure that there are no overlaps with other operations or airspace constraints (e.g., airports or restricted areas).” (DJI-1005, 6.) “Once the USS determines that the submitted Operation Volume is clear of other operations and constraints, the operator is notified that it is ‘Accepted’ and the operation can commence within the specified times.” (DJI-1005, 6.)

The USS further provides “a level of monitoring and conformance checking as a means of ensuring that a given flight is performing appropriately.” (DJI-1005, 5.) When an operation becomes “Active”, “position data for the flight is sent from the vehicle to the USS via a UTM client interface (typically integrated with a Ground Control Station).” (DJI-1005, 6.) “While ‘Active,’ position updates are required at regular intervals to the USS, and each of the updates is checked in relation to the bounds of the Operation Volume as a means of conformance monitoring.” (DJI-1005, 6.) If a vehicle nears the outer bounds, a ‘Non-

Conforming’ message is sent to provide the operator with “the opportunity to bring the flight back into conformance.” (DJI-1005, 6.) If the operator cannot control the vehicle and avoid an Operation Volume breach, “the operation transitions to a ‘Rogue’ state.” (DJI-1005, 6.) At this point, the UAS “must land and close.” (DJI-1005, 6.)

c. Integrated UTM-DNET System

The integrated UTM and D-NET system “is focused on the safe and efficient use of sUASs in immediate post-disaster relief operations.” (DJI-1005, 8.) The integrated system has “two main stages – planning and in-flight.” (DJI-1005, 8.) During the flight planning stage (Figure 7, left below), “D-NET is responsible for the generation of optimal flight plans for both manned and unmanned aircraft.” (DJI-1005, 8.)

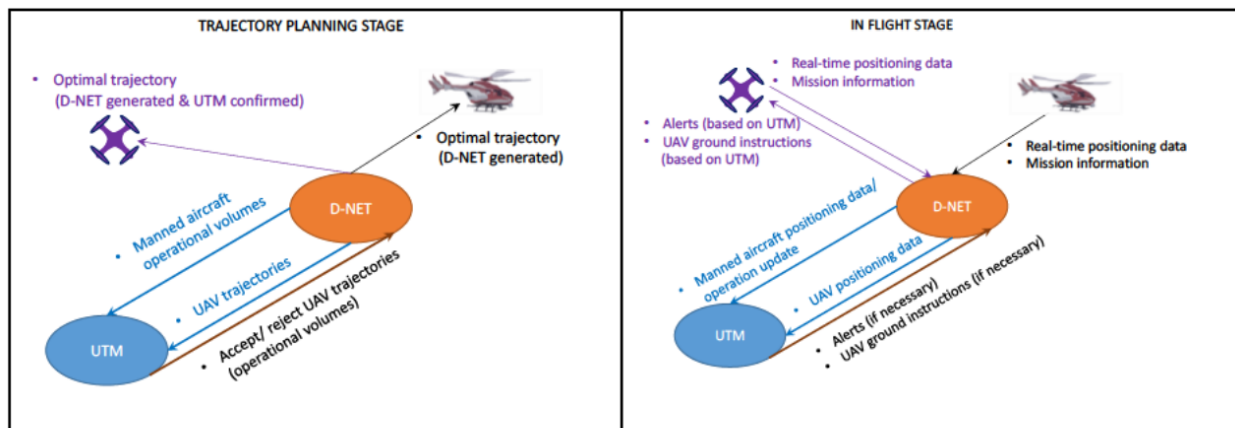


Fig.7. UTM and D-NET conceptual interaction at the flight planning (left) and in-flight stages (right)

UTM-DNET’s system architecture and information flow are illustrated in Figure 8 below. (DJI-1005, 9.) D-NET includes an “optimization subsystem” (not

shown) that “generate[s] flight trajectories[/plans] for all aircraft” based on input data from external components such as “aircraft databases, satellites, and supplementary data providers.” (DJI-1005, 8.) D-NET stores data on the available fleet and onboard equipment and “real-time data on reconnaissance and rescue mission demands.” (DJI-1005, 8.) For manned aircraft, D-NET’s optimization system submits the manned aircraft operational volumes to the UTM. (DJI-1005, 8.) For unmanned aircraft, D-NET submits the generated flight plans to UTM “as line segments defined by time-stamped waypoints” to UTM “for verification.” (DJI-1005, 8, 11-12, Fig. 12.) These flight plans are “either accepted when they meet the safety constraints imbedded in the system, or otherwise rejected.” (DJI-1005, 8.) The acceptance/rejection is fed back to D-NET “for further planning and optimization.” (DJI-1005, 8.) If UTM approves the flight plan, D-NET sends the flight plan to its respective UAS through the UAS Ground Station. (DJI-1005, 8.) If UTM rejects the flight plan, D-NET “re-optimiz[es] the plan against the rest of the missions” and re-submits it to UTM. (DJI-1005, 8.)

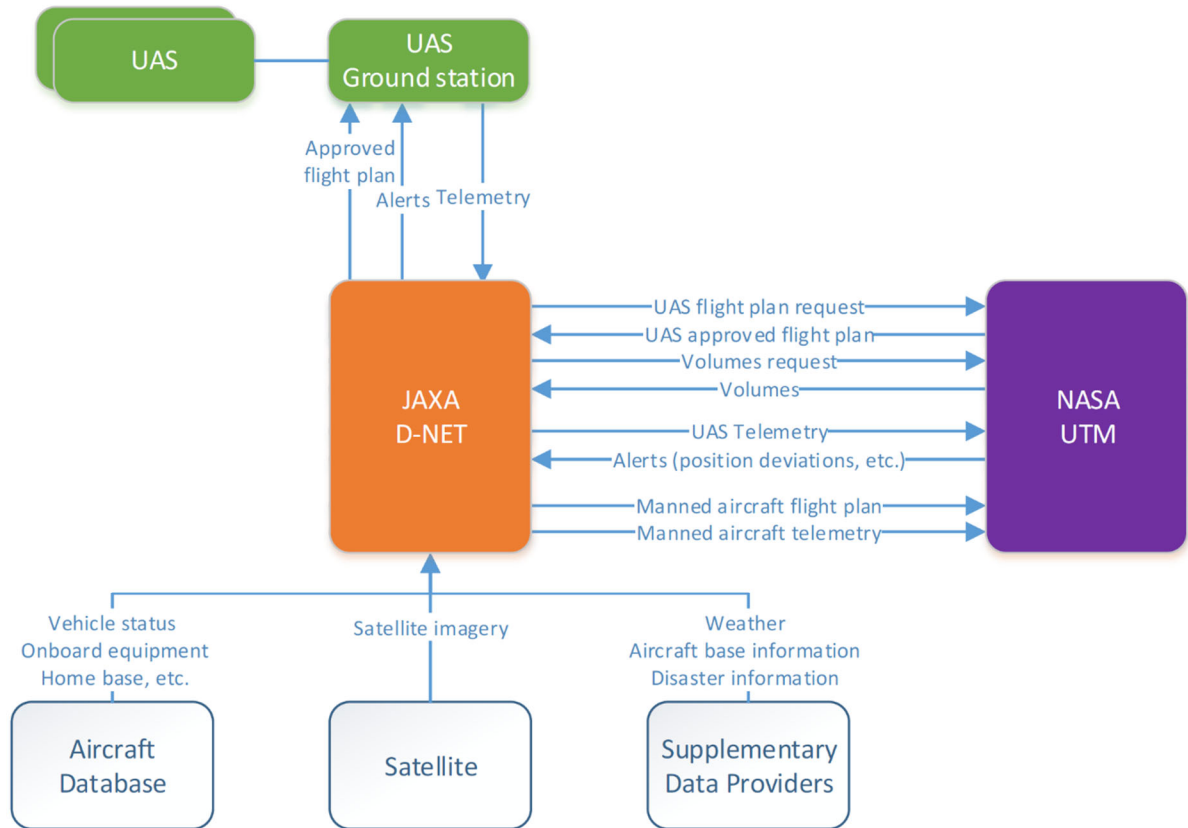


Fig. 8 Potential architecture and information flow between D-NET and UTM

During the in-flight stage, “D-NET provides the tracking data of the aircraft engaged in disaster relief missions to UTM.” (DJI-1005, 8.) The UTM then “issue[s] alerts if unmanned aircraft do not conform to their operation volumes, or if a manned aircraft is expected to enter the airspace in use.” (DJI-1005, 8.)

2. Butler

Butler relates to “a scalable, flexible, automated, air traffic control and flight plan management system for drones.” (DJI-1006, 1:4-6. 3:7-9.) Butler’s system 200, illustrated in Figures 1 and 2 below, includes servers 210 and storage devices 220 having one or more databases such as database 400 that maintains a collection

of executable flight plans 410 [red]. (DJI-1006, 2:1-3, 4:4-12, 4:41-44.) System 200 further includes zone controllers 60 that “control[] air traffic for a particular air traffic control zone.” (DJI-1006, 11:22-30.)

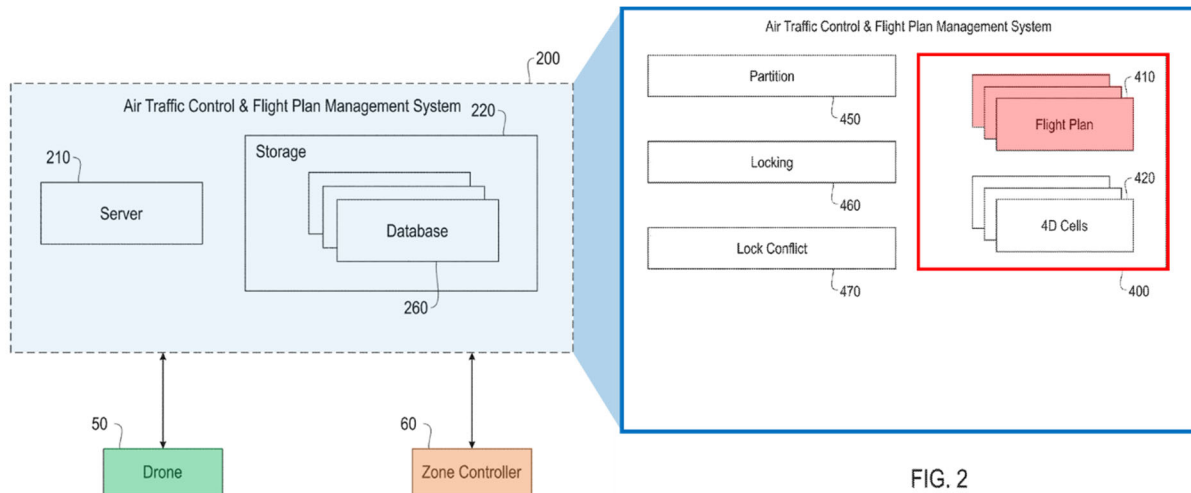


FIG. 1

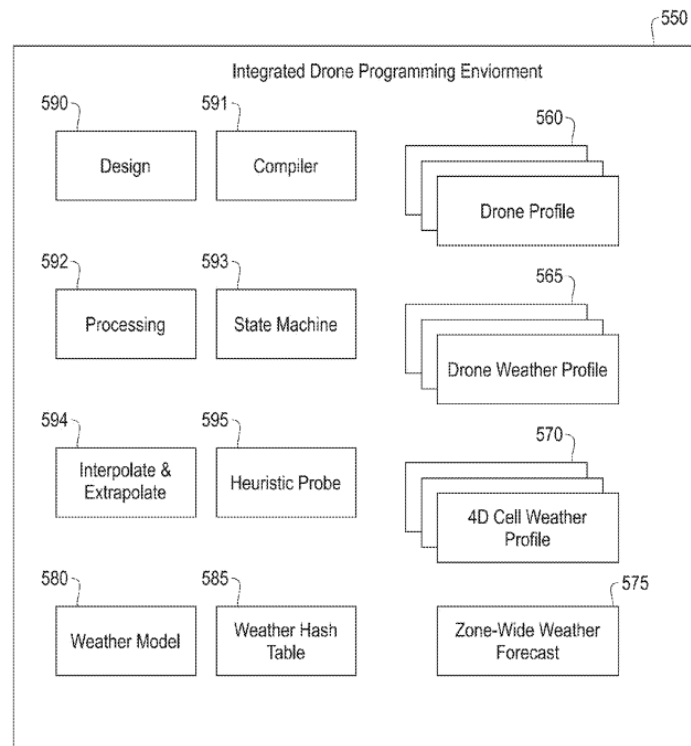
FIG. 2

Butler, Figures 1 and 2 (annotated).

Butler uses a “high level programming language for execution by a drone, the high level programming language compatible with a scalable, flexible, automated, air traffic control and flight plan management system for drones.” (DJI-1006, 12:55-59.) Butler’s system 200, shown above, “receive[s], as input, flight plan requests including flight plans designed using the high level programming language.” (DJI-1006, 12:67-13:5.)

System 200 further includes framework 550 for a drone programming environment, illustrated below. Framework 550 includes “design unit 590

configured to design a flight plane for a drone 50 (FIG. 1) using the high level programming language, and generate a flight plan request for the drone 50 that includes the flight plan.” (DJI-1006, 14:1-4.) The high level programming language “comprises different high level control instructions representing actions that are understandable and describable by humans.” (DJI-1006, 14:5-8.)



Butler, Figure 7

Butler further includes “a drone adaptor configured to adapt an executable flight plan for a drone 50 to a drone specific API 650” for the drone. (DJI-1006, 18:42-44.) The drone adaptor may be “an onboard drone adaptor” or a “remote adaptor implementing synchronous radio translation using a compute thread on a server 680 (FIG. 9) of a zone controller 60.” (DJI-1006, 18:46-49.) The drone

adaptor provides commands to the drone-specific API 650 that “include low level commands addressing servos at individual rotors of the drone 50, such as low level commands that increase or decrease rotational speed, or change orientation of the rotors, with respect to a chassis of the drone 50.” (DJI-1006, 19:12-22.)

3. Combination of UTM-DNET and Butler

A POSITA would have been motivated to combine the teachings of Butler with UTM-DNET’s system for controlling UAS in immediate post-disaster relief operations. First, a POSITA would have been motivated to incorporate Butler’s teachings regarding flight plan design including the design unit teachings and the drone adaptor teachings into the D-NET system of UTM-DNET. (DJI-1003, ¶¶73-92.)

UTM-DNET discloses that the optimization subsystem of the D-NET system “assign[s] missions and generate[s] flight trajectories for all aircraft.” (DJI-1005, 8.) However, UTM-DNET does not provide any details regarding how these flight plans are generated. UTM-DNET further discloses that verified flight plans are sent “to the UAS ground base, which will convey it to the vehicle.” (DJI-1005, 8.) However, UTM-DNET does not provide details regarding the interface required to provide flight plans to UAS. A POSITA would have therefore been motivated to search for references describing details for generation of flight plans and the communication of the flight plans to UAS and would have been led to Butler. (DJI-

1003, ¶¶74.) Both UTM-DNET and Butler are in the same field as the '972 patent—vehicle fleet control.

A POSITA would have been further motivated to combine UTM-DNET and Butler to permit the interoperability of the UTM-DNET system with a variety of different UAS models and UAS manufacturers. (DJI-1003, ¶¶75-77.) UTM-DNET suggests such interoperability, stressing the need to support a wide-range of aircraft: “[t]ypically, multiple organizations support relief activities and this often creates logistics coordination challenges between agencies which can result in wasted time or resources.” (DJI-1005, 1.) More specifically, “when aircraft belong to different organizations (e.g., Japan self-defense forces, fire departments and medical services), real-time telemetry and mission-related information cannot be shared, as no common operational platform exists.” (DJI-1005, 2.) UTM-DNET further discloses the use of commercial off-the-shelf (COTS) UAS, industrial grade UAS, and fully-equipped high performance UAS in disaster relief efforts. (DJI-1005, 14.) A POSITA would have understood that these UAS include different capabilities with COTS UAS having more limited functionality and interfaces than the industrial grade or fully-equipped devices. (DJI-1003, ¶¶78-79.) Thus, a POSITA would have recognized that incorporating flight planning design unit and drone adaptors in either the D-NET system or UAS to convert high-level

commands into low-level commands would have provided the ability for the D-NET/UTM systems to work with any UAV. (DJI-1003, ¶80.)

The combined UTM-DNET and Butler system is simply the application of a known technique (flight planning design and conversion of high-level commands to low-level commands) to a known device (the D-NET system) to yield predictable results (flight plans that can be executed by a UAS). (DJI-1003, ¶¶81-82.) The results of the combination would have been predictable to a POSITA and a POSITA would have had a reasonable expectation of success in the combination because defining a flight plan as a series of instructions/commands was well-known as was the use of an adaptor to interface with an application programming interface (API). (DJI-1003, ¶83.) For example, UTM-DNET suggests that flight planning is performed by software (DJI-1005, 5) and the remote drone adaptor is implemented as “a compute thread on a server ... of a zone controller,” which a POSITA would have understood to mean a computing process running on a remote server. (DJI-1003, ¶82.) Thus, a POSITA would have had a reasonable expectation of success in modifying D-NET software to add flight planning and adaptation because a POSITA would have had a background in software development. (DJI-1003, ¶83.)

Second, a POSITA would have been motivated to store the flight plans generated by the D-NET system that are submitted to UTM for verification in

storage associated with the D-NET system, such as a database. UTM-DNET suggests such storage. UTM-DNET teaches that the D-NET system submits the generated flight plans “as line segments defined by time-stamped waypoints” to UTM “for verification.” (DJI-1005, 8, 11-12, Fig. 12.) These flight plans are “either accepted when they meet the safety constraints imbedded in the system, or otherwise rejected.” (DJI-1005, 8.) The acceptance/rejection is fed back to D-NET “for further planning and optimization.” (DJI-1005, 8.) To “further” optimize a flight plan, the D-NET system must have access to the original flight plan submitted to UTM. (DJI-1003, ¶84.) Thus, a POSITA would have understood that the generated flight plan is stored at the D-NET system. (DJI-1003, ¶85.)

D-NET further suggests that verified flight plans are stored at the D-NET system. A POSITA would have been motivated to indicate the status of a flight plan (e.g., initial, verified, etc.) so that the system knows whether a stored flight plan has been verified. (DJI-1003, ¶86.) UTM-DNET provides visualization (illustrated for example in Figure 12 below) and operational awareness during disaster relief efforts when the verified flight plans are being performed. (DJI-1003, ¶87.) UTM-DNET discusses the benefits of providing enhanced operational awareness: “**having an awareness of where operations are planned** or are currently taking place can aid operators and managers in planning and managing their own operations and allocation of resources.” (DJI-1005, 5.) Operational

awareness was also emphasized in the D-NET and UTM systems themselves, both of which provided users the capability of visualizing planned and ongoing operations. (See DJI-1005, 10-11, Figures 10-11; DJI-1003, ¶¶88-89.) Indeed, the UTM research team considered a user interface with real-time access to UTM information about nearby operations to be a “**clear necessity.**” (DJI-1005, 11.) To that end, “[f]light plans, operational volumes, and telemetry” are “visualized on **D-NET’s interface** and used by response management at local disaster relief centers to follow the mission progress.” (DJI-1005, 9.) “This visualization is ... expected to **increase the situational awareness** and reduce any redundant communication regarding position updates and mission status.” (DJI-1005, 9.)

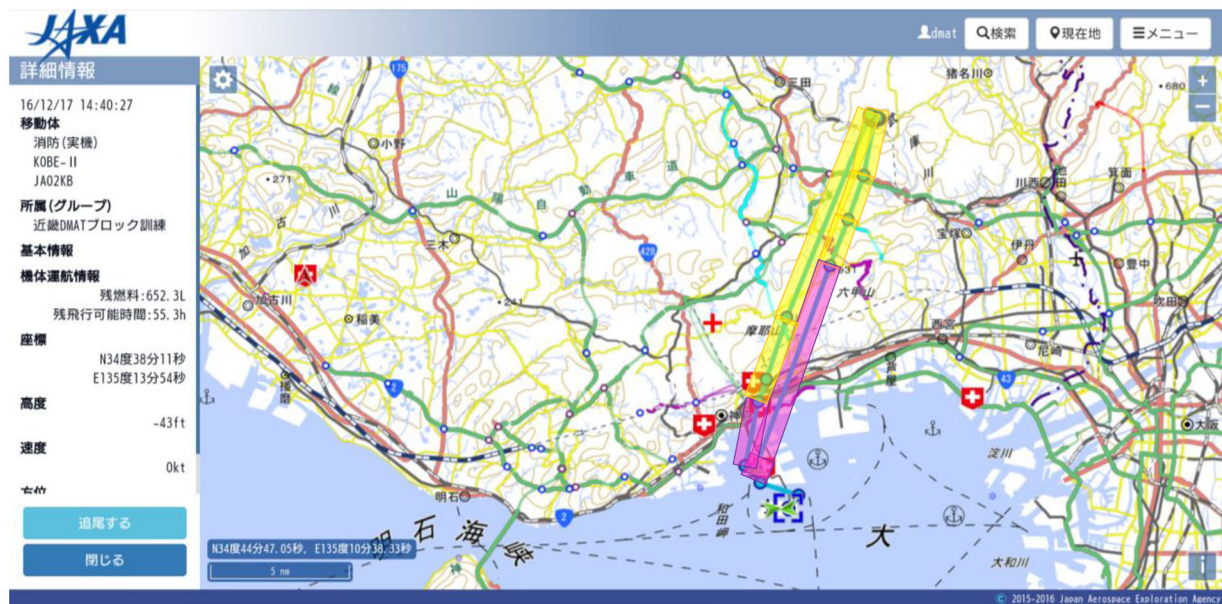


Fig. 12 Example of proposed D-NET/UTM integrated visualization

UTM-DNET suggests use of a database by disclosing the use of an “Aircraft Database” for storing “Vehicle status, Onboard Equipment, and Home Base, etc.”

(DJI-1005, 9.) A POSITA therefore would have been motivated to modify the D-NET system to either (1) store flight plans in the existing database or (2) incorporate a separate database for storing flights plans. (DJI-1003, ¶90.)

Moreover, Butler suggests use of a database to store flight plans. (*See*, DJI-1006, 2:1-3, 4:4-12, 4:41-44.) A POSITA would have been motivated to combine Butler’s flight plan storage teachings with UTM-DNET. (DJI-1003, ¶91.) As discussed above, UTM-DNET suggests the storage of flight plans at various stages of planning and operation in a database. (DJI-1003, ¶84-89.) A POSITA would have been motivated to incorporate Butler’s flight plan storage teachings into UTM-DNET to support the flight-plan re-optimization and visualization functionalities of UTM-DNET. (DJI-1003, ¶91.)

A POSITA would have further been motivated to combine the flight plan storage teachings of Butler with UTM-DNET to “**coordinate[] information sharing** amongst different relief agencies,” which UTM-DNET explains is critical when responding to catastrophic events. (DJI-1005, 1; *see also*, 2 (“[I]nsufficient or uncoordinated rescue demand information sharing might cause duplicate mission assignments and inefficiencies in search, rescue, and supply missions.”).) Accordingly, information “collection and sharing” is a key focus of both D-NET and the integrated UTM-DNET system. (*See* DJI-1005, 1 (D-NET “assists **collection and sharing of disaster information** ... for efficient and safe rescue

operations by disaster relief aircraft”), 3 (D-NET’s objective “is to acquire data efficiently from multiple sources such as satellites, helicopters, and **unmanned aircraft systems** to enable the analysis of these data in order to provide an optimal resource allocation and flight trajectory plan(s)”).) The combination would further UTM-DNET’s stated objective of collecting and sharing information amongst different relief agencies by creating a central repository for disaster-response operation information. (DJI-1003, ¶92.)

This combination of UTM-DNET with Butler is simply the application of a known technique (using a database to store flight plans) to a known device (a UAS fleet management system) to yield predictable results (operational awareness for all stakeholders in UAS system). (DJI-1003, ¶93.) The results of the combination would have been predictable to a POSITA and a POSITA would have had a reasonable expectation of success in the combination because the system described in UTM-DNET already interfaces with a database: “D-NET generates vehicle mission assignments and flight plans based on information ... obtained through the **aircraft database.**” (DJI-1005, 8.) A POSITA would understand that the UTM-DNET system would interface with the Aircraft Database and Butler’s database of executable flight plans in the same way or even combine the two into a single database. (DJI-1003, ¶93.)

B. Independent Claim 1

1. Preamble [1P]³

The “main components of the integrated system are UTM, D-NET, UAS ground stations, and **vehicles**.” (DJI-1005, 8.) Vehicles managed by the integrated system in “a disaster response environment” include manned and unmanned assets such as sUAS. (DJI-1005, 1-2, 8.) Specifically, the integrated system focuses “on the safe and efficient use of sUASs in immediate post-disaster relief operations.” (DJI-1005, 8.)

Although UTM-DNET discusses the use of piloted UAS, a POSITA would have understood that the UTM-DNET unmanned vehicle fleet includes autonomous⁴ vehicles. (DJI-1003, ¶95.) First, UTM-DNET suggests some level of autonomous operation by disclosing support for Beyond Visual Line of Sight (BVLOS) operation. (See DJI-1005, 14.) Second, UTM is designed to manage autonomous vehicles. (DJI-1003, ¶95 *citing* DJI-1014, 4 (“**The UTM will support** a wide variety of UAS from those equipped with minimalistic avionics to **autonomous UAS**.”), Figure 1; DJI-1018, 6 (“**UTM will accommodate** a diverse

³ Petitioner does not acquiesce the preamble is limiting.

⁴ The ’972 patent does not provide a definition for or provide a discussion of what constitutes an “autonomous” vehicle or operation.

inventory of UAS. ... the vehicles will span the entire spectrum of control mechanisms from remotely piloted to command-directed and **fully autonomous systems.**"); DJI-1027, 10 ("As a set, the successive iterations will support development of the range of UAS operations for each operating environment - from remotely piloted aircraft to command-directed UAS and **fully autonomous UAS.**") Finally, Butler discloses autonomous UAS, teaching that flight plans are provided to individual drones to execute. (*See, e.g.*, DJI-1006, 18:42-19:22.) The combination of UTM-DNET and Butler discloses an "*autonomous vehicle fleet*" used for disaster response. (DJI-1003, ¶96; *see also*, DJI-1001, 2:25-27 (vehicle includes "flying vehicles, such as drones").)

UTM-DNET teaches an "*autonomous vehicle fleet control method.*" (DJI-1003, ¶¶97-100.) The goal of the integrated system is "to leverage core capabilities that have been developed as part of UTM and integrate them with D-NET in order to provide the ability to deploy and **manage sUAS** as part of wider disaster response efforts." (DJI-1005, 2.) UTM-DNET explains that for large-scale disasters, "hundreds of aircraft are deployed and engaged in search and rescue missions." (DJI-1005, 3.) The integrated system provides "**overall coordination** and integration of all aircraft" by "optimiz[ing] the performance" of available vehicles, including manned aircraft and unmanned aircraft, "by assigning missions according to the vehicle's equipment, state, and location." (DJI-1005, 3, *see also*,

DJI-1005, 1-2, 11 (describing “multiple operations conducted by independent operators ... tak[ing] place in close proximity”).) D-NET transmits flight plans to UASs for execution. (DJI-1005, 8 (“If a flight plan is accepted, D-NET will send it to the UAS ground base, which will convey it to the vehicle.”).) During mission execution, D-NET receives position data from the UAS and (with UTM) “checks their conformance with submitted flight plans and assigned operational volumes.” (DJI-1005, 9; *see also*, 8, Figure 7 (right).) When non-conformance is detected, D-NET “**requir[es] the UAS to adjust its behavior.**” (DJI-1005, 9.) Thus, D-NET controls each UAS in the UTM-DNET system during a disaster recovery effort. (DJI-1003, ¶¶98-100.) The combination of UTM-DNET and Butler therefore discloses “[a]n autonomous vehicle fleet control method.” (DJI-1003, ¶¶97-100.)

2. “*Obtaining*” Limitation [1A]

The combination of UTM-DNET and Butler discloses “*a master schedule*” having one or more “*mission entr[ies]*” which are each associated with “*a mission for a vehicle of a fleet of autonomous vehicles.*” (DJI-1003, ¶101.) The objective of “integrated aircraft operation system for disaster relief” (D-NET) is to “provide an optimal resource allocation and flight trajectory plan(s)” which are “integrated into actual rescue operations.” (DJI-1005, 3.) The D-NET system maintains data “on the available aircraft fleet” and the “real-time data on reconnaissance and rescue mission demands.” (DJI-1005, 8.) D-NET’s optimization subsystem uses this data

“to **assign missions and generate flight trajectories for all aircraft.**” (DJI-1005, 8.) For example, “D-NET plans and assigns **data acquisition missions** to UAS in order to spare resources from the manned aircraft fleet so that more helicopters can be assigned to rescue missions.” (DJI-1005, 3.) Thus, UTM-DNET discloses generation of “*mission[s] for a vehicle of a fleet of autonomous vehicles.*”

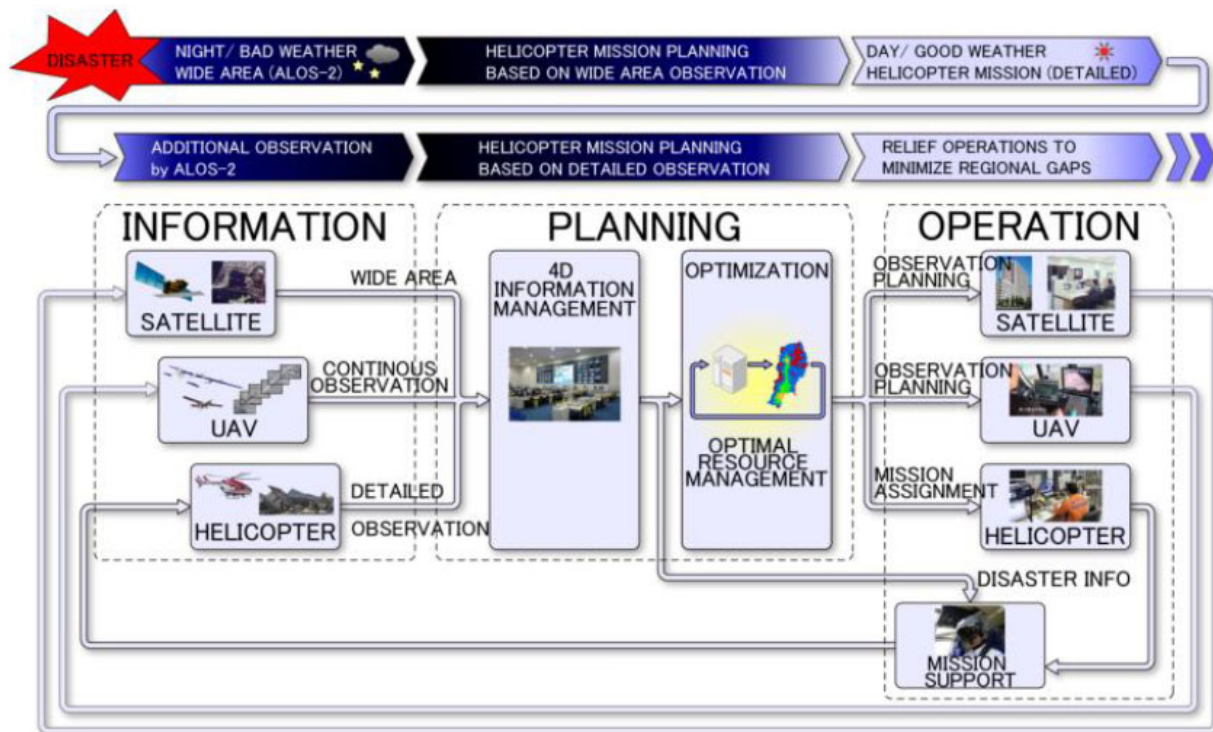


Fig. 1 D-NET operations.

As discussed in §V.A.3, the collection of missions/flight trajectories generated for the manned and unmanned vehicles by D-NET’s optimization subsystem is stored in a database, as taught by Butler. This stored collection of missions/flight trajectories (plans) is a “*master schedule*” for a disaster relief effort

because it maintains the missions/flight trajectories (plans) to be performed during the operation phase of the relief effort. (DJI-1003, ¶¶102-06.)

Each entry (individual mission/flight trajectory) in the database includes a unique identifier, an earliest requested flight time and/or latest desired arrival time, and the planned flight path including the departure location⁵ and one or more arrival locations, as taught by Butler. (*See* DJI-1006, 4:66-5:10; *see also*, 1:32-36, 3:10-14, claims 1, 9, 17.) These entries are “*mission entries*” that are associated with “*missions*” (and vice versa). Thus, the combination of UTM-DNET and Butler discloses that each “*mission is associated with a mission entry of the master schedule.*” (DJI-1003, ¶107.)

UTM-DNET’s “*master schedule*” (collection of missions/flight trajectories) is consistent with PO’s interpretation of the term in its infringement contentions in the co-pending litigation. (DJI-1013, 6-11.) Specifically, PO alleges that the Task Plan Library used by DJI Flighthub 2 (illustrated below), which stores a collection of task plans, each including a flight route and task performance time, meets the “*master schedule*” limitation. (*See Id.*) UTM-DNET’s “*master schedule*” is also consistent with the Examiner’s interpretation during prosecution. (*See*, DJI-1002, 176-190.)

⁵ A location identified in a flight path is commonly referred to as a waypoint.

The screenshot displays a software interface for a 'Task Plan Library'. On the left is a sidebar with a 'Production Plant' section containing a tree view of tasks like 'L1 Inspection', 'Clock No. 1', and 'Clock No. 2'. The main area shows a table of flight plans. At the top, there's a 'Create Plan' button and filters for date (2022-05-07 00:00 to 2022-05-13 23:59) and type (All Types). The table has columns for Planned/Actual Time, Status, Type, Plan Name, Flight Route Name, Doc Name, Creator, Media File Upload, and Actions. The data shows a series of 'L1 Inspection' tasks scheduled at 08:30 on various dates in May 2022, all with a status of 'To be performed' and a type of 'Timed & Recurring'.

Planned/Actual Time	Status	Type	Plan Name	Flight Route Name	Doc Name	Creator	Media File Upload	Actions
2022-05-07								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-08								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-09								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-10								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-11								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-12								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]
2022-05-13								
08:30 08:31	To be performed	Timed & Recurring	L1 Inspection	L1 Inspection	No.1	L1 Inspect	--	[Edit] [Delete] [Duplicate]

Infringement Contentions, Exhibit D.

UTM-DNET discloses a “*fleet controller*.” (DJI-1003, ¶110.) The D-NET system is “designed as a **portable system for aircraft operation management** in the immediate aftermath of a large-scale disaster.” (DJI-1005, 3.) The D-NET system, illustrated in Figure 1 above, includes “three main blocks: 1) data/information acquisition, 2) optimal planning block and 3) operation execution block.” (DJI-1005, 3.) Thus, the D-NET system controls the fleet of unmanned and manned vehicles and is therefore a “*fleet controller*.” (DJI-1003, ¶¶110-11.)

During the planning stage described in UTM-DNET, the optimization subsystem of the D-NET system sends generated flight plans to UTM for verification. (DJI-1005, 8.) Although not explicitly disclosed by UTM-DNET, a

POSITA would have understood that the generated flight plans sent to UTM are retrieved (“*obtained*”) from the missions/flight trajectories (“*mission entr[ies]*”) stored in the database of the combined system of UTM-DNET and Butler. (DJI-1003, ¶112.) Thus, the combination of UTM-DNET and Butler teaches “*obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule*” [1A]. (DJI-1003, ¶¶101-12.)

3. “Identifying” Limitation [1B]

The combination of UTM-DNET and Butler discloses “*identifying a flight path associated with the mission*” [1B]. (DJI-1003, ¶113.) UTM-DNET’s flight trajectory/plan specifies the path of the UAV during a mission and therefore includes the claimed “*flight path.*” (DJI-1003, ¶¶113-14.) UTM-DNET’s flight plans, illustrated in the excerpt from Figure 4 below, are “line segments defined by time-stamped waypoints” (locations identified in the flight plan). (DJI-1005, 11.)



UTM-DNET, Figure 4 (left panel).

In the combined system, a flight plan is stored as part of a mission entry in the master schedule, and is thus “*associated with the mission*”, because it is required for mission execution. (DJI-1005, 8 (“If a flight plan is accepted, D-NET will send it to the UAS ground base, which will convey it to the vehicle.”); DJI-1003, ¶115.) The combination of UTM-DNET and Butler therefore discloses that the D-NET system (the “*fleet controller*”) “*identif[ies] a flight path associated with the mission*” [1B]. (DJI-1003, ¶¶113-15.)

4. “*Verifying*” Limitation [1C]

The combination of UTM-DNET and Butler discloses “*verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM).*” (DJI-1003, ¶116.) In UTM-DNET, generated flight plans “are sent to

UTM for verification.” (DJI-1005, 8.) The UTM “accept[s] or reject[s] the submitted UAS flight plan” based “on its own criteria.” (DJI-1005, 8.) For example, the UTM system determines whether the operation volume for the flight plan overlaps with other volumes. (*See, e.g.*, DJI-1005, 4.) If UTM approves the flight plan (flight plan is useable), D-NET sends the flight plan to its respective UAS through the UAS Ground Station. (DJI-1005, 8.) If a flight plan is rejected (i.e., the flight plan is not useable), D-NET “correct[s] it by re-optimizing the plan” and “re-submit[ting it] to UTM.” (DJI-1005, 8.) Thus, the D-NET system “verif[ies] a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM)” [1C]. (DJI-1003, ¶116.)

a. “Traffic” [1C.1]

The combination of UTM-DNET and Butler discloses “*the UTM performs checking on the flight path for traffic in the flight path*” [1C.1]. (DJI-1003, ¶117.) During the planning stage, when a flight plan is received from D-NET, UTM “performs checks on the airspace to ensure that there are no overlaps with other operations[.]” (DJI-1005, 6; *see also*, 4 (“A USS also uses the Operation Volume for strategic deconfliction of airspace by checking proposed volumes from other operators within the same USS and from other USSs to ensure that there is no overlap in time and space of volumes.”); DJI-1003, ¶117.) Volumes from other operators are “*traffic*” and an overlap in volumes indicates “*traffic in the flight*

path.” (DJI-1003, ¶¶117-18.) UTM-DNET thus discloses “*wherein the UTM performs checking on the flight path for traffic in the flight path*” [1C.1].⁶ (DJI-1003, ¶¶116-119.)

b. “*Flight Restrictions*” [1C.2]

During the planning stage, the UTM also performs checks on “airspace constraints (e.g., airports or restricted areas).” (DJI-1005, 6.) A POSITA would have understood that restricted areas and/or airports are areas in which a UAV is restricted from flying (i.e., a flight restriction). (DJI-1003, ¶120.) In addition, “basic operational constraints based on vehicle capabilities and minimum required separation are imposed”; for example, UAS “operate in UAS assigned airspace only.” (DJI-1005, 8.) By checking on airspace and operational constraints, the combination of UTM-DNET and Butler thus teaches that, in addition to “*checking*

⁶ PO’s infringement contentions appear to assert that this limitation is satisfied by preventing drones from “flying routes into restricted airspace” and ensuring a flight route is compliant with “flight safety and restriction updates.” (DJI-1013, 18-25.) Petitioner discusses UTM-DNET’s disclosure of such functionality in §V.B.4.b in the context of the claimed “*flight restrictions.*” However, to the extent PO is correct that such functionality is also covered by this limitation, UTM-DNET teaches it for the reasons discussed below.

the flight path for traffic in the flight path,” “the UTM performs checking on the flight path for ... availability of the flight path due to flight restrictions” [1C.2].

(DJI-1003, ¶¶120-23.)

c. “Requirements For Use” [1C.3]

Limitation [1C.3] recites that the UTM also checks for “*requirements for use of the flight path.*” The ’972 patent provides examples of flight path use requirements including “weight or size, minimum or maximum altitude or airspeed, or the like.” (DJI-1001, 8:67-9:4; *see also* claims 7, 14, and 20 (defining “*requirements for use*” as “compris[ing] at least one of weight, size, minimum or maximum altitude, or airspeed”).)

The UTM in UTM-DNET checks the flight path for “minimum or maximum altitude.” (DJI-1003, ¶¶124-27.) “[U]nmanned aircraft flight plans are submitted to UTM, where they can be either accepted when they meet the safety constraints imbedded in the system, or otherwise rejected.” (DJI-1005, 8, Figure 7 (left).) The “safety constraints imbedded in the [UTM] system” include constraints on minimum and maximum altitude. (DJI-1003, ¶126 *citing* DJI-1016, 21 (listing “min_altitude_wgs84_ft” and “max_altitude_wgs84_ft” as required fields “used to describe an operation volume” that define the minimum and maximum altitudes, respectively, for the operation corresponding to the operation volume); *see also*,

84-85.) This requirement is reflected by the Operation Volume defined by the UTM during verification process. (See, DJI-1005, 4; §V.A.1.)

For this reason, the combination of UTM-DNET and Butler teaches “*the UTM performs checking on the flight path for ... requirements for use of the flight path*” [1C.3] in addition to “*traffic in the flight path [and] availability of the flight path due to flight restrictions*”. (DJI-1003, ¶¶124-27.)

5. “*Modifying*” Limitation [1D]

The combination of UTM-DNET and Butler discloses “*modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified*” [1D]. (DJI-1003, ¶128.) As discussed above in §V.B.4, the DNET system sends generated flight plans to UTM for verification. The UTM’s “**flight plan acceptance/rejection is** feedback to D-NET and **input for further planning and optimization.**” (DJI-1005, 8.) If UTM rejects a flight plan (“*usability of the flight path is not verified*”), D-NET’s optimization subsystem “**re-optimiz[es] the plan** against the rest of the missions and re-submit[s] it to UTM.” (DJI-1005, 8.)

In the exemplary flight plan rejection illustrated in Figure 9 below left, Operation (Flight Plan) 002001 was rejected “due to **overlapping times** in first and final segments.” (DJI-1005, 9-10.) The identification of the specific reason for the rejection is “*data from the UTM in response to the UTM indicating that the*

usability of the flight path is not verified.” (DJI-1003, ¶129.) In response to the rejection, the D-NET system uses the received data to adjust the flight plan. In this example, the D-NET system “**re-optimized and time-shifted**” the flight plan for Operation 002001 “**to avoid the overlap**” with the flight plan for Operation 001001.

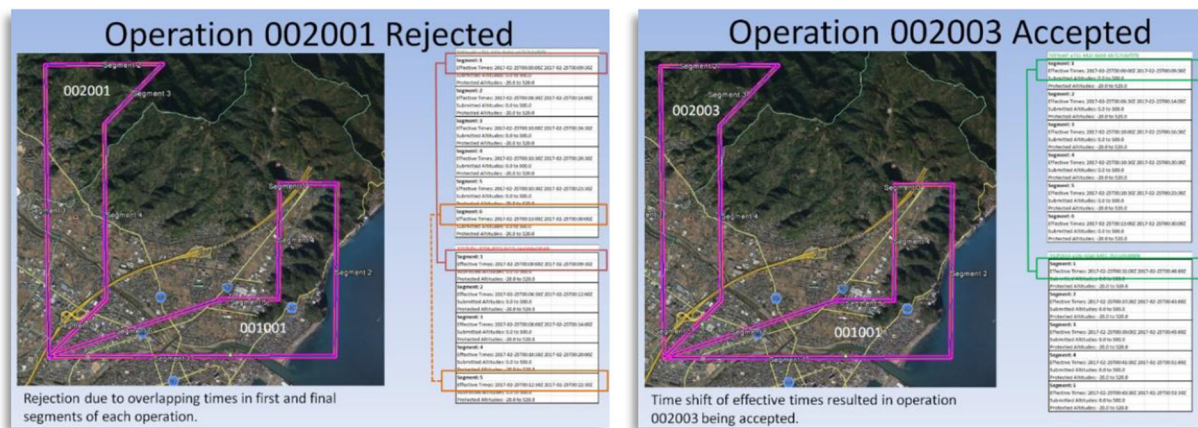


Fig. 9 UTM/D-NET collaborative simulation example

UTM-DNET, Figure 9.

The combination of UTM-DNET and Butler therefore teaches “*modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified*” [1D]. (DJI-1003, ¶¶128-30.)

6. “Generating” Limitation [1E]

The combination of UTM-DNET and Butler discloses “*generating vehicle commands according to mission parameters associated with the mission based on the flight path*” [1E]. (DJI-1003, ¶131.) During relief operations, DNET assigns missions, such as “general reconnaissance, search, rescue, and transportation of

personnel and goods,” to available disaster relief aircraft. (*See, e.g.*, DJI-1005, 2-3.) For example, D-NET “plans and assigns data acquisition missions to UAS in order to spare resources from the manned aircraft fleet so that more helicopters can be assigned to rescue missions.” (DJI-1005, 3.) Broader applications for UAS in disaster relief efforts including “supply delivery and continuous monitoring” are contemplated by D-NET. (DJI-1005, 3.)

In addition to the mission objective (e.g., reconnaissance), each mission has other associated “*mission parameters*” such as mission duration and altitude associated with the mission flight path. During the planning stage, the D-NET system “generates vehicle mission assignments and flight plans based on information from available resources (obtained through the aircraft database), satellite imagery showing flooded areas, for example, and disaster area information.” (DJI-1005, 8.) During the process of flight path generation, “basic operational constraints based on vehicle capabilities and minimum required separation are imposed.” (DJI-1005, 8.) Further, as part of the verification process of the flight plan with UTM, UTM “sends operational volumes along with the accepted flight plans” to the D-NET system. The operational volume “represents a 3D volume ... of where an intended operation is to occur with an associated temporal component that defines the duration for when that volume or segment

will be active.” (DJI-1005, 5.) That is, the operational volume defines the time, area and altitude limits for a verified UAS mission.

The verified flight plans associated with these missions are “integrated into actual rescue operations.” (DJI-1005, 3.) As shown in Figure 7 (below left), as part of the planning stage, the flight trajectory (plan) is communicated to the UAV. Specifically, in the UTM-DNET system, “[i]f a flight plan is accepted, D-NET will send it to the UAS ground base, which will convey it to the vehicle.” (DJI-1005, 8.)

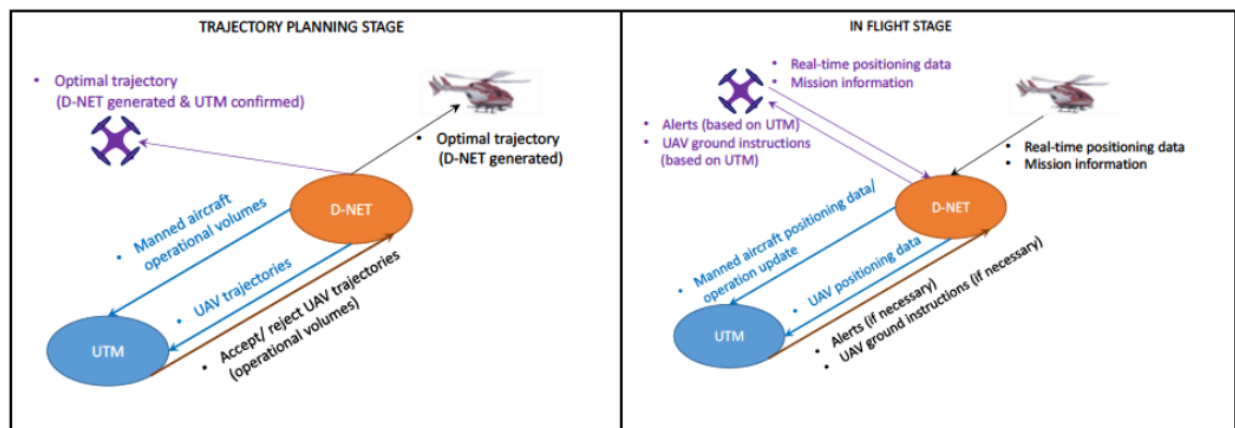


Fig.7. UTM and D-NET conceptual interaction at the flight planning (left) and in-flight stages (right)

To be executed by the UAS, the verified flight plan associated with the mission and its mission parameters generated by UTM-DNET is converted to a set of “high level control instructions representing actions that are understandable and describable by humans” by a design unit, as taught by Butler, which is integrated into the D-NET system (*see* §V.A.3). (DJI-1006, 14:5-8.) Exemplary high-level instructions (commands) used to define a flight plan include the following:

Takeoff (x) represents an action that causes a drone to takeoff and rise up to the elevation x

Land (): represents an action that causes a drone to land at a current latitude and longitude.

From loc 1 proceed to loc 2: represents an action that causes a drone to move from loc1 to loc2. Each location is converted to latitude and longitude.

Move vertical from elevation1 to elevation2: represents an action that causes the drone to move vertically from the first elevation to the second elevation while maintaining a current latitude and longitude.

Complete by (t): represents a deadline by which a flight plan for a drone must be completed.

(DJI-1006, Table 4.) Table 5 illustrates an exemplary flight plan for a UAV:

TABLE 5

from loc1 takeoff and rise elevchange1 feet
from loc1 proceed to loc2
from loc2 land at beacon2
grasp package
from loc2 takeoff and rise elevchange2 feet
from loc2 proceed to loc1
from loc1 land at beacon1
release package

This flight plan causes the UAV to “operate as follows: (1) takeoff from location loc1 and rise up by net elevation elevchange1 in feet, (2) move from location loc1 to location loc2, (3) from location loc2, land at beacon beacon2, (4) grasp package at beacon beacon2, (5) takeoff from location loc2 and rise by net elevation elevchange2 in feet, (6) move from location loc2 to location loc1, (7) from location

loc1, land at beacon beacon1, and (8) release the package at beacon beacon1.”

(DJI-1006, 15:26-49.) Through the generation of high-level instructions (commands) implementing the flight path, the combination of UTM-DNET and Butler discloses “*generating vehicle commands according to mission parameters associated with the mission based on the flight path*” [1E]. (DJI-1003, ¶¶132-37.)

Should PO contend that the high-level programming commands are not “*vehicle commands*,” Butler further describes a “drone adaptor configured to adapt an executable flight plan for a drone 50 to drone specific API 650 (FIG. 8) for the drone 50.” (DJI-1006, 18:42-44.) The drone adaptor may be “an onboard drone adaptor” or a “remote adaptor implementing synchronous radio translation using a compute thread on a server 680 (FIG. 9) of a zone controller 60.” (DJI-1006, 18:44-49.) The flight path commands provided to the drone specific API 650 by the drone adaptor “include low level commands addressing servos at individual rotors of the drone 50, such as low level commands that increase or decrease rotational speed, or change orientation of the rotors, with respect to a chassis of the drone 50.” (DJI-1006, 19:13-17.) Thus, the combination of UTM-DNET and Butler discloses limitation [1E] under an interpretation of “*vehicle command*” as low-level commands that address UAV servos. (DJI-1003, ¶138.)

7. “Maintaining” Limitation [1F]

The combination of UTM-DNET and Butler discloses “*maintaining a persistent connection with the vehicle.*” (DJI-1003, ¶¶139-46.) UTM-DNET describes various types of connections between a UAS, ground station, and the D-NET system. The connection between the UAS and ground station is a C2 (command and control) link, illustrated below. The connection between the UAS/ground station and UTM/DNET systems varies. For example, industrial grade sUAS are equipped with SATCOM allowing “UTM/D-NET connection without ground-based infrastructure.” (DJI-1005, 13.) For high performance sUAS, the available communication capabilities provide the ability to operate the UAS “from the non-damaged area into the damaged area.” (DJI-1005, 13.) Thus, the combination of UTM-DNET and Butler discloses “*a connection with the vehicle.*” (DJI-1003, ¶139.)

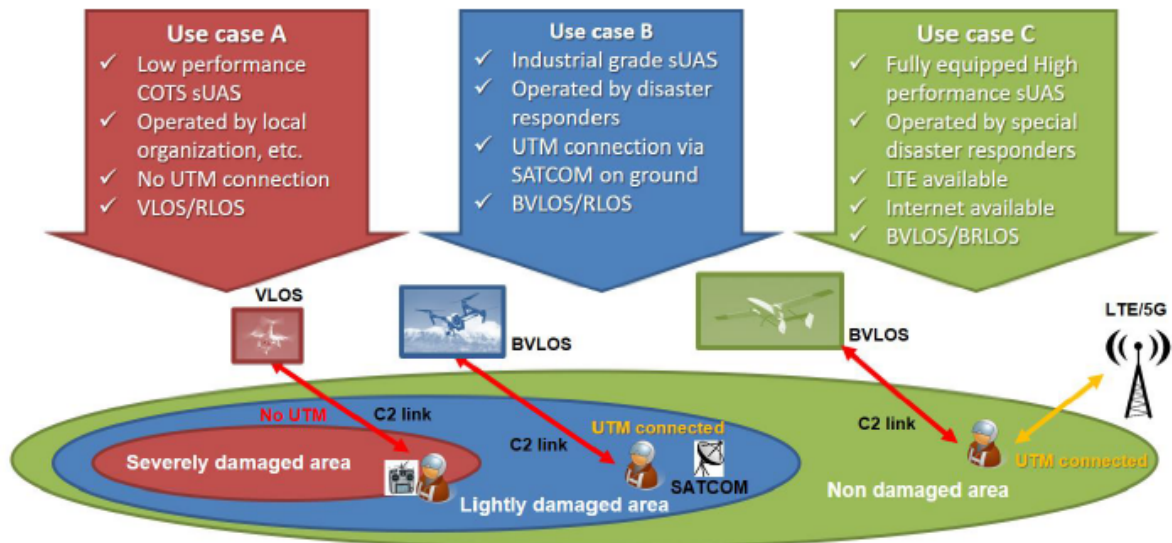


Fig. 13 Operation cases in a disaster response situation with integrated D-NET and UTM interactions.

As discussed in §V.B.6, the most common mission for a UAV in disaster relief efforts is reconnaissance. (See DJI-1005, 9.) Although not explicitly stated in UTM-DNET, a POSITA would have understood that reconnaissance⁷ by a UAS involved continuous observation of a video stream or images provided from the UAS. (DJI-1003, ¶140.) Indeed, one example provided by UTM-DNET is “[w]hen a critically injured victim is found by a UAS.” (DJI-1005, 9.) A communications connection providing continuous streaming of video or images from a UAS through the ground station (or directly) to the D-NET system is a “*persistent*

⁷ A reconnaissance mission is equivalent to the continuous observation performed by a UAV as part of the “data/information acquisition block.” (See DJI-1005, 3; DJI-1003, ¶140.)

connection.” (DJI-1003, ¶¶140-44; *see also*, DJI-1013 (Infringement Contentions), 42 (equating video streaming to a persistent connection).) Thus, the combination of UTM-DNET and Butler discloses “*maintaining a persistent connection with the vehicle.*” (DJI-1003, ¶144.)

UTM-DNET additionally “provide[s] a level of monitoring and conformance checking as a means of ensuring that a given flight is performing appropriately.” (DJI-1005, 5.) Specifically, vehicles submit “position updates ... at a defined rate (e.g., 1 Hz) throughout the entirety of an operation.” (DJI-1005, 5; DJI-1003, ¶145 (a rate of 1 Hz means one update is sent every second).) A POSITA would understand that establishing a new connection for each such update would be inefficient because a certain amount of overhead is required whenever a connection is established—the two devices need to find each other, negotiate the connection parameters, and authenticate, for example. (DJI-1003, ¶146.) Thus, a POSITA would have been motivated to use a “*persistent connection with the vehicle*” to provide the position updates to UTM. For this additional reason, the combination of UTM-DNET and Butler discloses or at least suggests “*maintaining a persistent connection with the vehicle*” [1F]. (DJI-1003, ¶¶139-46.)

8. “Sending” Limitation [1G]

The combination of UTM-DNET and Butler discloses “*sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the*

*vehicle to execute the mission under control of the fleet controller” [1G]. (DJI-1003, ¶¶147-48.) As discussed *supra* §V.A.3, in the combined UTM-DNET/Butler system, the flight plan (trajectory) is transmitted to the UAS as a sequence of instructions (commands) over the connection between the D-NET system, ground station, and the UAS. For a UAS with an onboard adaptor, the D-NET system sends the flight plan as a sequence of high-level commands to the ground station which sends the plan to the UAS where the onboard adaptor converts the commands to low-level commands for the drone specific API. (See DJI-1006, 18:42-46, 18:50-62; §V.A.3.) For a UAS without an onboard adaptor, the remote adaptor in the D-NET system converts executable flight plans into drone-specific low-level commands and sends the commands to the ground station which sends the commands to “the drone specific API 650” of the drone 50. (DJI-1006, 18:42-44, 18:63-19:10.) The low-level commands “address[] servos at individual rotors of the drone 50” causing the drone to “increase or decrease rotational speed, or change orientation of the rotors, with respect to a chassis of the drone 50.” (DJI-1006, 19:12-22.)*

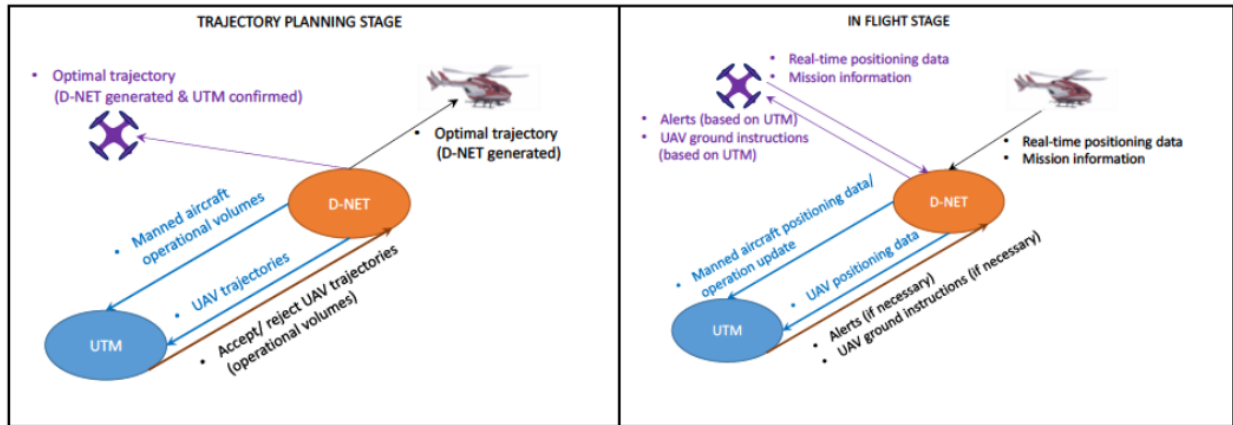


Fig.7. UTM and D-NET conceptual interaction at the flight planning (left) and in-flight stages (right)

The combination of UTM-DNET and Butler therefore discloses “*sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller*” [1G]. (DJI-1003, ¶¶147-148.)

9. “Monitoring” Limitation [1H]

The combination of UTM-DNET and Butler discloses “*monitoring operation of the vehicle during performance of the mission*” [1H] in at least two ways. (DJI-1003, ¶¶149-51.)

First, UTM-DNET discloses “*monitoring operation of the vehicle*” through its visualization tools. (DJI-1003, ¶150.) In UTM-DNET, flight plans are “**visualized on D-NET’s interface** and used by response management at local disaster relief centers **to follow the mission progress.**” (DJI-1005, 9.) For example, in the Insight UTM (iUTM) interface illustrated below, “the graphical display on the right gives users an understanding of the overall airspace and where

operations are in relation to one another.” (DJI-1005, 11.) The operations list view (at left) “is a gateway into a detailed view of the selected operation with, for example, a record of messages received, operation state, and vehicle state information.” (DJI-1005, 11.)

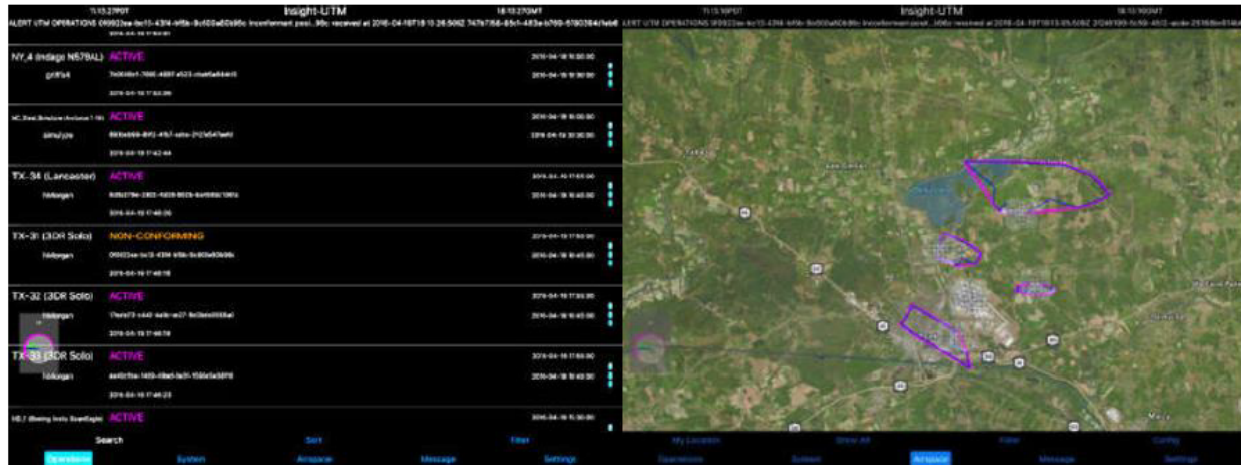


Fig. 11 Interactive user interface for UTM operations

Second, UTM-DNET discloses “*monitoring operation of the vehicle*” through its flight conformance checking. (DJI-1003, ¶151.) During the in-flight stage, “D-NET provides the tracking data of the aircraft engaged in disaster relief missions to UTM” which “can then issue alerts if unmanned aircraft do not conform to their operation volumes, or if a manned aircraft is expected to enter the airspace in use.” (DJI-1005, 8.) Specifically, “position data is sent from the UAS though [sic] the [UAS Ground Station] and D-NET to UTM, which checks their conformance with submitted flight plans and assigned operational volumes.” (DJI-1005, 9.) If a non-conformance is detected by UTM, “an alert is sent to D-NET requiring the UAS to adjust its behavior.” (DJI-1005, 9.)

C. Independent Claim 8

1. Preamble [8P]

For the reasons discussed in §V.B.2, the combination of UTM-DNET and Butler thus discloses a “*fleet controller* [D-NET system] *for controlling an autonomous vehicle fleet*” [8P].

2. “*Fleet Controller*” Structural Limitations [8A]-[8B]

The D-NET system is implemented using a “**server**” which is a computer or a program executing on a computer that provides information in response to external requests. (DJI-1005, 10; *see* DJI-1031, 483.) UTM-DNET does not disclose the well-known implementation details of the D-NET server. However, Butler describes the well-known architecture of a computer system. Specifically, Butler explains that a computer system includes “one or more processors.” (DJI-1006, 30:33-34.) The computer system further includes removable storage that “includes a computer readable medium having stored therein computer software and/or data.” (DJI-1006, 30:53-55.) Thus, Butler discloses “*a processor*” and “*a non-transitory computer-readable storage medium storing a program to be executed by the processor.*” (DJI-1003, ¶154.)

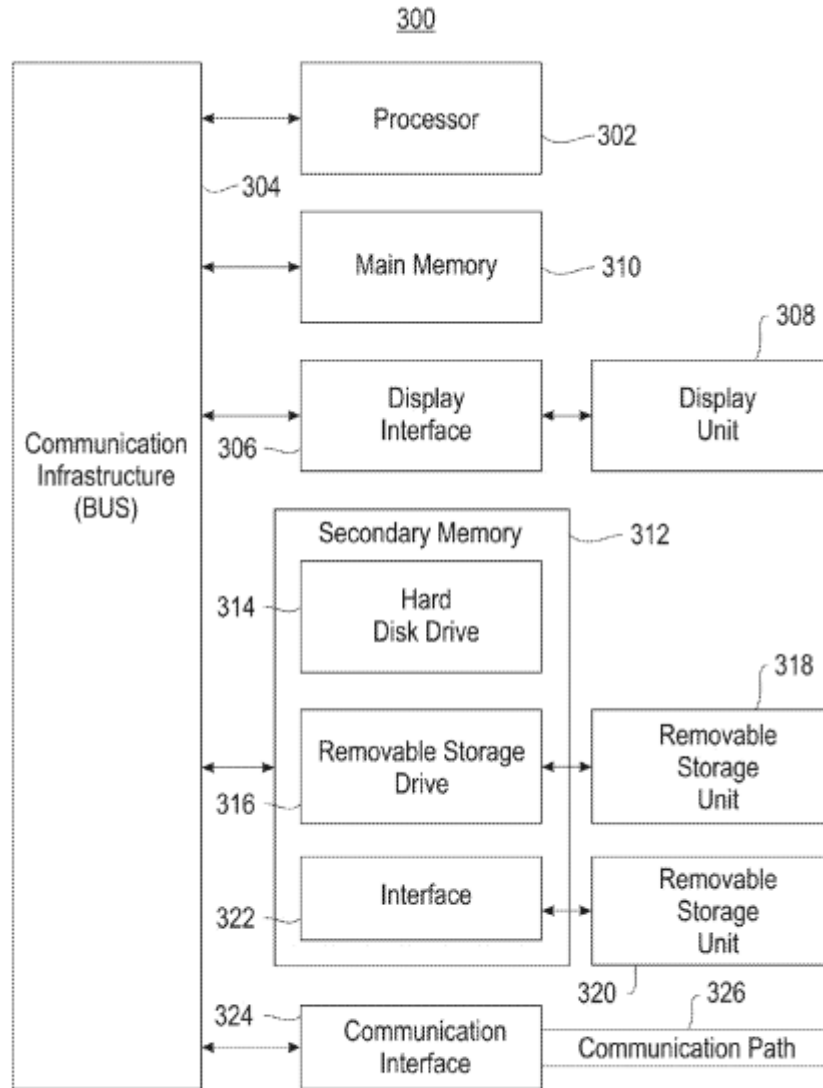


FIG. 18

Butler, Figure 18

A POSITA would have understood that the server of UTM-DNET is implemented using Butler's conventional computer system because a server is (or requires) a computer and the basic components of a conventional computer system (processor/storage) are needed to execute software. (DJI-1003, ¶155.) A POSITA would have further understood that the D-NET system functionality is

implemented by software (a program). First, UTM-DNET’s disclosure that D-NET is implemented using a server suggests the functionality is implemented as software. (DJI-1003, ¶155; DJI-1031, 483 (server includes “computer or program”).) Second, UTM-DNET discloses “flight planning software” (DJI-1005, 5) and “control software” (DJI-1005, 7), suggesting the functionality performed by the D-NET system (flight planning and control) is performed by software. (DJI-1003, ¶155.)

Thus, the combination of UTM-DNET and Butler teaches or at least suggests a “*fleet controller*” comprising “*a processor*” [8A] and “*a non-transitory computer-readable storage medium storing a program to be executed by the processor, the program including instructions for*” [8B] performing the recited steps. (DJI-1003, ¶¶153-56.)

3. Limitations [8C]-[8G]

Limitations [8C]-[8G] recite substantially similar subject matter as limitations [1A]-[1H]. For the reasons set forth in the sections listed in the table below, the combination of UTM-DNET and Butler discloses limitations [8C]-[8G]. (See DJI-1003, ¶157.)

Claim 8	
[8C] obtaining, from a master schedule, ...	§V.B.2
[8D] identifying a flight path ...	§V.B.3

Claim 8	
[8E] verifying a usability of the flight path with a [UTM]	§V.B.4
[8E.1] ... traffic ...	§V.B.4.a
[8E.2] ... flight restrictions ...	§V.B.4.b
[8E.3] ... requirements for use ...	§V.B.4.c
[8F] modifying the flight path ...	§V.B.5
[8G] generating vehicle commands ...	§V.B.6

4. “Maintaining ... through a communications network” [8H]

Limitation [8H] is identical to limitation [1F] except limitation [8H] additionally requires that the persistent connection between the “*fleet controller*” and “*vehicle*” is maintained “*through a communications network.*” As discussed above in §V.B.7, UTM-DNET describes various types of connections between a UAS and the D-NET system including SATCOM and the cellular LTE network. (DJI-1005, 13.) A POSITA would understand SATCOM and LTE to be each be an example of a “*communications network.*” (DJI-1003, ¶158.) The combination of UTM-DNET and Butler therefore discloses this limitation.

5. Limitations [8I]-[8J]

Limitations [8I]-[8J] recite substantially similar subject matter as limitations [1G]-[1H]. For the reasons set forth in the sections listed in the table below, the

combination of UTM-DNET and Butler discloses limitations [8I]-[8J]. (See DJI-1003, ¶159.)

Claim 8	
[8I] sending the vehicle commands ...	§V.B.8
[8J] monitoring operation of the vehicle ...	§V.B.9

D. Independent Claim 15

1. Preamble [15P]

The combination of UTM-DNET and Butler discloses the subject matter of claim 15’s preamble for the reasons discussed above in §V.C.1.

2. “*Vehicle*” [15A]

The combination of UTM-DNET and Butler discloses this limitation for the reasons discussed above in §V.B.1.

3. “*Communications Network*” [15B]

The combination of UTM-DNET and Butler discloses this limitation for the reasons discussed above in §V.C.4.

4. “*Fleet Controller ... Communications Network*” [15C]

For the reasons discussed above in §V.C.4, the combination of UTM-DNET and Butler discloses a “*fleet controller in communication with the vehicle by way of the communications network*” [15C].

5. Limitations [15D]-[15K]

Limitations [15D]-[15H] and [15J]-[15K] recite substantially similar subject matter as limitations [1A]-[1E] and [1G]-[1H], respectively.⁸ Furthermore, limitation [15I] recites substantially similar subject matter as limitation [8H]. For the reasons set forth in the sections listed in the table below, the combination of UTM-DNET and Butler discloses limitations [15D]-[15K]. (See DJI-1003, ¶164.)

Claim 15	
[15D] obtain, from a master schedule, ...	§V.B.2
[15E] identify a flight path ...	§V.B.3

⁸ Limitation [15J] discloses “*send[ing] the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle commands,*” whereas limitations [1G] and [8I] disclose “*sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller.*” Limitation [15J] is substantially similar to limitations [1G] and [8I] because “*receiv[ing] the vehicle command*” from the “*fleet controller*” and “*execut[ing] the mission according to the vehicle commands*” [15J] means that “*the vehicle commands caus[e] the vehicle to execute the mission under control of the fleet controller.*” (DJI-1003, ¶164 n.5.)

Claim 15	
[15F] verify a usability of the flight path with a [UTM]	§V.B.4
[15F.1] ... traffic ...	§V.B.4.a
[15F.2] ... flight restrictions ...	§V.B.4.b
[15F.3] ... requirements for use ...	§V.B.4.c
[15G] modify the flight path ...	§V.B.5
[15H] generate vehicle commands ...	§V.B.6
[15I] maintain a persistent connection ...	§V.C.4
[15J] send the vehicle commands ...	§V.B.8
[15K] monitor operation of the vehicle ...	§V.B.9

E. Dependent Claims

1. Claims 2, 9, and 16

The combination of UTM-DNET and Butler teaches or at least suggests that the “*fleet controller*” (D-NET system) “*obtain[s] the mission from the master schedule according to a priority of mission entries in the master schedule*” [2]/[9]/[16]. (DJI-1003, ¶¶16570.)

The UTM system “incorporates the capability for certain **operations**⁹ to **have an associated priority status** with an associated level of priority access to

⁹ An “operation” in UTM-DNET corresponds to the claimed “mission.”

the airspace,” noting that “**priority operations [are] particularly relevant in public safety and disaster response situations.**” (DJI-1005, 7.) Priority status is declared to the UTM “as part of an operation submission from authorized entities that have elevated privileges.” (DJI-1005, 7.)

Based on the support for priority operations by the UTM system discussed in UTM-DNET, a POSITA would have been motivated to include a priority status associated with each flight plan (mission) stored in the “*master schedule*” or alternatively stored missions in priority order of execution in the “*master schedule*” in the combined system of UTM-DNET and Butler for a variety of reasons. (DJI-1003, ¶¶167-69.) First, UTM-DNET discloses that a disaster response effort includes different phases. (DJI-1005, 1.) A POSITA would have therefore been motivated to assign missions to UAVs on a per phase basis. (DJI-1003, ¶167.) For example, missions in the first phase (e.g., data acquisition/reconnaissance) have a higher priority than missions in a later phase. Thus, first phase missions are obtained from the master schedule before later phase missions.

Second, UTM-DNET discloses prioritization of missions based on the type of aircraft. D-NET assigns missions “according to the vehicle’s equipage, stage, and location.” (DJI-1005, 3; DJI-1003, ¶168.) For example, D-NET “assigns data acquisition missions to UAS in order to spare resources from the manned aircraft fleet so that more helicopters can be assigned to rescue missions.” (DJI-1005, 3.)

Reconnaissance/data acquisition missions occur first in order to identify victims for later rescue by manned aircraft. (*See, e.g.*, DJI-1005, 9 (“When a critically injured victim is found by a UAS, for example, a medevac helicopter must reach this victim”).) Thus, UAV reconnaissance missions are prioritized before certain types of manned missions (*e.g.*, rescue and delivery missions).

Third, during rescue, D-NET discloses that manned vehicles are treated as “priority vehicles.” (DJI-1005, 10.) Thus, the master schedule would reflect a manned rescue mission as higher in priority than UAS missions. In this way, UTM uses the positions of manned vehicles to alert UAVs as necessary. (DJI-1005, 10.) For example, to reach a victim found by a UAS, the manned helicopter must enter UAS assigned airspace. (DJI-1005, 9.) By making the manned helicopter rescue mission a higher priority than the UAS mission, a POSITA would have understood that the UTM issues alerts to modify the lower-priority UAS flight plan or to delay a UAS flight plan in the manned aircraft’s operation volume to avoid the manned helicopter. (DJI-1003, ¶169.)

The combination of UTM-DNET and Butler thus teaches or at least suggests “*obtain[ing] the mission from the master schedule according to a priority of mission entries in the master schedule*” [2]/[9]/[16]. (DJI-1003, ¶¶165-70.)

2. Claim 3

Claim 3 recites “*monitoring operation of the vehicle comprises monitoring a connection of the vehicle to a communications network associated with the fleet controller.*” (DJI-1003, ¶¶171-75.) The ’972 patent describes “*monitoring a connection of the vehicle to a communication network*” broadly as encompassing “monitor[ing] for periodic message initiated by the vehicles.” (DJI-1001, 10:55-60; *see also*, DJI-1013 (Infringement Contentions), 64 (equating “monitoring the connection” to “‘real-time situational awareness,’ supervis[ing] the fleet, live stream[ing] missions, synchroniz[ing] mission status, device status, and mission details”).) The combination of UTM-DNET and Butler discloses claim 3. (DJI-1003, ¶174.)

UTM-DNET provides real-time situational awareness and fleet supervision through its continuous “monitoring and conformance checking” function. Specifically, position updates are “submitted to [UTM] at a defined rate (e.g., 1 Hz) throughout the entirety of an operation.” (DJI-1005, 5.) “**Each update is checked** whether it is inside the Operation Volume or outside in order to determine the flight’s conformance.” (DJI-1005, 5.) If the vehicle nears the outer bound of a volume, “a ‘Non-Conforming’ message is sent to alert the operator of the situation and provide the opportunity to bring the flight back into conformance.” (DJI-1005, 6.) If the UAS operator is “unable to control the vehicle,” operation “transitions to

a ‘Rogue’ state.” (DJI-1005, 6.) At this point, the UAS “must land.” (DJI-1005, 6.) A POSITA would further have understood that loss of communication between the UAS/ground station and the D-NET system and therefore lack of position updates would be indicative of a situation where the UAV operator is unable to control the vehicle. (DJI-1003, ¶173.)

Thus, the combination of UTM-DNET and Butler discloses “*monitoring operation of the vehicle comprises monitoring a connection of the vehicle to a communications network associated with the fleet controller*” [3]. (DJI-1003, ¶¶171-75.)

3. Claim 4

The main components of the UTM-DNET system are the UTM system, the D-NET system, UAS ground stations, and vehicles, illustrated in Figure 8 below. When a UAS mission is active, “position data is sent from the UAS through the ground station and D-NET to UTM, which checks their conformance with submitted flight plans and assigned operational volumes.” (DJI-1005, 9.) The UAS ground station is therefore an “*access point*” for one or more UAS (as shown below). (DJI-1003, ¶¶176-77; *see also*, DJI-1013 (Infringement Contentions), 68 (equating a UAV “dock and/or pilot RC controller” to an “*access point*”).)

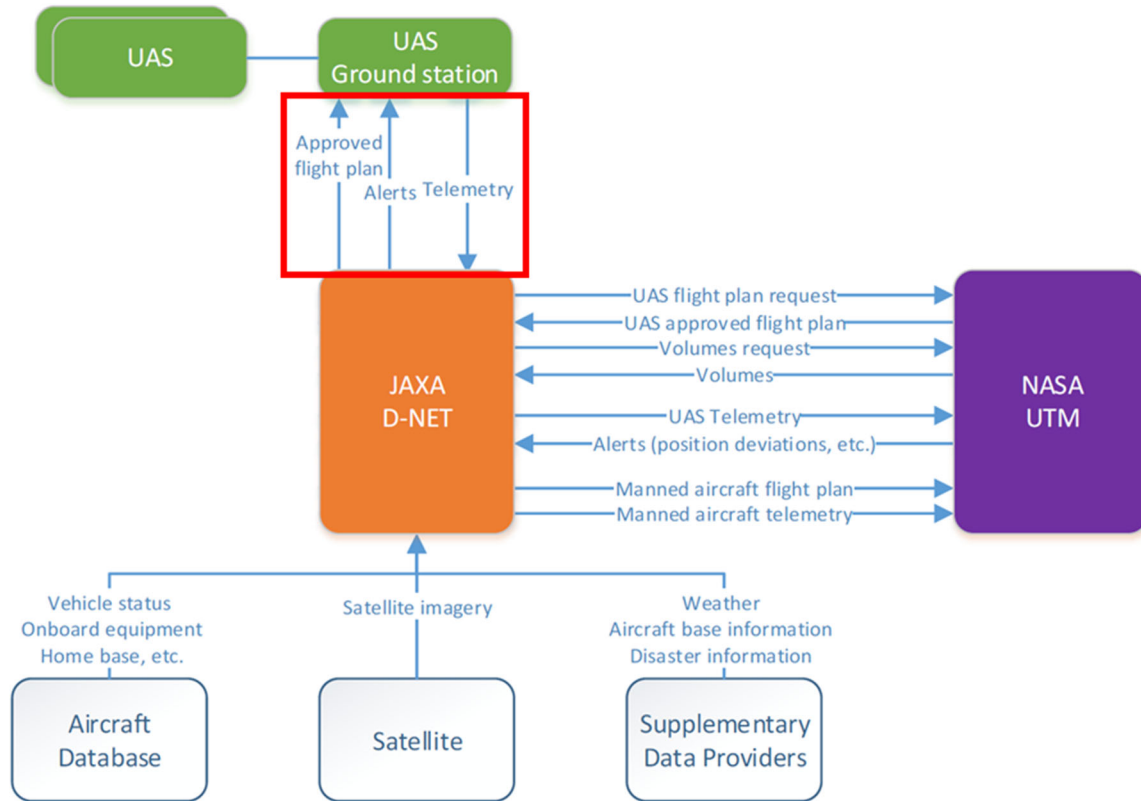


Fig. 8 Potential architecture and information flow between D-NET and UTM

UTM-DNET, Figure 8 (annotated)

A POSITA would have understood that a UAS ground station is a ground-based control system for one or more UAS. For example, UTM-DNET explains that commercial off-the-shelf (COTS) sUAS require ground communication infrastructure (ground station) for UTM/D-NET support. (See DJI-1005, 13.) As shown in Figure 8 above, the ground station receives flight plans from D-NET for one or more UAS and receives telemetry data (e.g., real-time position) from each UAS and forwards this data to the D-NET system, as discussed above. Accordingly, for the same reason that the D-NET system discussed in §V.E.2

performs “*monitoring*” of “*a connection*” between the vehicle and the D-NET system, the ground station (“*access point*”) “*monitor[s] ... a connection between the vehicle and the access point*” [4A] by receiving and forwarding position updates. (DJI-1003, ¶¶177-78.)

The combination of UTM-DNET and Butler therefore discloses “*monitoring, by an access point of the communications network, a connection between the vehicle and the access point*” [4A]. (DJI-1003, ¶178.)

The combination of UTM-DNET and Butler further discloses “*reporting, by the access point, a last vehicle status to the fleet controller*” [4B]. (DJI-1003, ¶179.) The ’972 patent explains that “[i]n some embodiments, the last vehicle status is the most recent status of the vehicle.” (DJI-1001, 8:10-11.) As discussed above, in UTM-DNET, when a UAS mission is active, “position data is sent from the UAS through the ground station and D-NET to UTM.” (DJI-1005, 9.) Thus, UTM-DNET discloses “*reporting, by the access point (ground station), a last vehicle status (the most recent status of a vehicle) to the fleet controller (DNET system).*” (DJI-1003, ¶179.)

Should PO contend limitation [4B] requires the “*last vehicle status*” be the last status update prior to a loss of the communication connection, the combination of UTM-DNET and Butler discloses this overly narrow construction. Butler explains that “in response to receiving as input a detected failure of a drone 50, the

system 200 responds with ... a notification that the drone 50 has gone missing near a **last known location** for the drone 50.” (DJI-1006, 4:31-37.) A POSITA would find it trivial to include in UTM-DNET’s system Butler’s teaching of transmitting an indication of a connection loss with a UAS (e.g., missing drone) with the last position received for the UAV before the connection loss. (DJI-1003, ¶180.) A POSITA would have been motivated to provide a real-time indication of a connection loss by the ground station with a UAV to D-NET and UTM to allow for UTM to incorporate this knowledge into its conformance monitoring and to permit the D-NET system to modify the UAV’s mission (e.g., to return to base for maintenance) should connection be re-established. (DJI-1003, ¶180.)

The combination of UTM-DNET and Butler further discloses “*reporting, by the access point, a last vehicle status to the fleet controller*” [4B]. (DJI-1003, ¶¶176-81.)

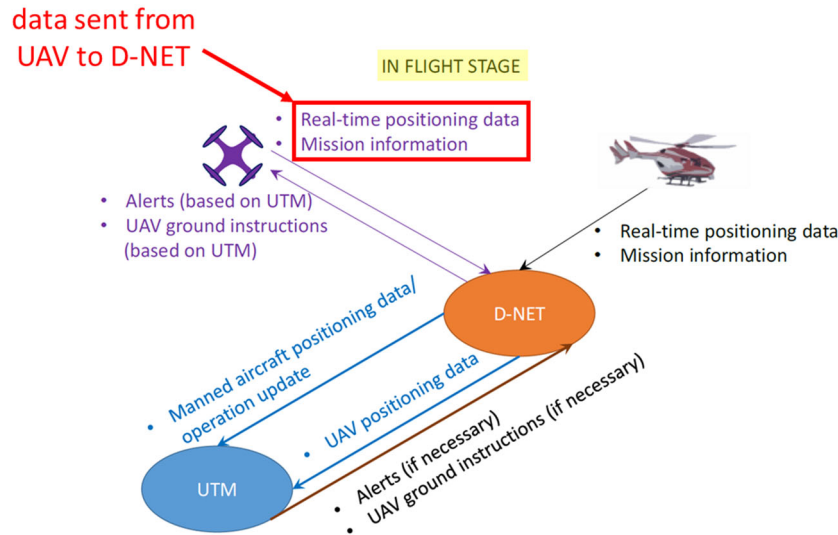
4. Claims 5, 11, and 18

a. “*Mission Parameters*” and “*Mission Impact Data*” [5A]/[11A]/[18A]

Limitations [5A]/[11A]/[18A] recite “*determin[ing], during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller.*” (DJI-1003, ¶¶182-85.) The ’972 patent provides three examples of “*mission impact data*”: (1) “event messages or requests sent by a vehicle,” (2) “UTM data,” and (3) “exterior

condition data.” (DJI-1001, 11:16-19.) The combination of UTM-DNET and Butler discloses limitations [5A]/[11A]/[18A].

As discussed above, when a UAS mission is active, “position data is sent from the UAS through the ground station and D-NET to UTM, which checks their conformance with submitted flight plans and assigned operational volumes.” (DJI-1005, 9.) The position data is “UTM data” (“*mission impact data*”) because it is used by the UTM system. (DJI-1003, ¶184, *citing* DJI-1001, 11:11-13 (UTM data includes “traffic updates or data”).) As discussed in §V.B.6, the operational volume includes “*mission parameters*” (time, area, and altitude limits for a UAS mission). (*See* DJI-1005, 5 (operational volume “represents a 3D volume ... of where an intended operation is to occur with an associated temporal component that defines the duration for when that volume or segment will be active.”).) (DJI-1005, 5.) If a non-conformance is detected by the UTM, “an alert is sent to D-NET requiring the UAS to adjust its behavior.” (DJI-1005, 9.) That is, a determination is made by the D-NET system (through contact with the UTM) “*whether the mission parameters are supported by mission impact data.*” (DJI-1003, ¶184.)



UTM-DNET, Figure 7 (right panel) (annotated)

Thus, the combination of UTM-DNET and Butler discloses “*determin[ing], during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller*” [5A]/[11A]/[18A]. (DJI-1003, ¶185.)

b. “Generating” [5B]/[11B]/[18B] and “Sending” [5C]/[11C]/[18C]

The combination of UTM-DNET and Butler discloses “*generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters*” [5B]/[11B]/[18B]. (DJI-1003, ¶¶186-88.) In UTM-DNET, [w]hen non-conformance is detected, an alert is sent to D-NET **requiring the UAS to adjust its behavior.**” (DJI-1005, 9.) Specifically, a “Non-Conforming” message

is sent to alert the operator of the situation and provide the opportunity to **bring the flight back into conformance.**” (DJI-1005, 9.)

A POSITA would have understood that to bring the UAV flight back into conformance, D-NET must generate and communicate (send) the necessary vehicle commands to the UAS (via the ground station) to return the UAS to the verified flight path or return the UAS to home base. (DJI-1003, ¶187.) As discussed *supra* §§§V.B.5, V.C.3, V.D.5 for claim elements [1D]/[8F]/[15G] and §§§V.B.6, V.C.3, V.D.5 for claim elements [1E]/[8G]/[15J], the combination of UTM-DNET and Butler teaches “*generating vehicle commands ... based on the flight path*” and “*sending the vehicle commands to the vehicle using the connection ... causing the vehicle to execute the mission.*” (DJI-1003, ¶187.)

For the reasons in these sections and the reasons discussed above, the combination of UTM-DNET and Butler discloses “*generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters*” [5B]/[11B]/[18B] and “*sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command*” [5C]/[11C]/[18C]. (DJI-1003, ¶188.)

5. Claims 7, 14, and 20

The combination of UTM-DNET and Butler discloses “*the requirements for use of the flight comprise at least one of weight, size, minimum or maximum altitude, or airspeed*” [7]/[14]/[20]. (DJI-1003, ¶189.) As discussed in §V.B.4.c for claim element [1C.3], the UTM in UTM-DNET checks the flight path for “minimum or maximum altitude” when checking the operation volume. (DJI-1003, ¶¶189-190.) Thus, for these reasons, the combination of UTM-DNET and Butler renders claims 7, 14, and 20 obvious.

6. Claims 10 and 17

The combination of UTM-DNET and Butler discloses [“*the instructions for the monitoring operation of the vehicle include instructions for receiving,*”]/[“*the fleet controller is configured to receive,*”] “*from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection*” [10]/[17]. (DJI-1003, ¶¶191-93.)

Butler explains that its system sends “a notification that [a] drone 50 has gone missing near a last known location for the drone 50” in response to “receiving as input a detected failure of [said] drone.” (DJI-1006, 4:31-37.) A POSITA would understand “a detected failure” indicating a “missing” UAV includes loss of the communication connection between the UAS Ground Station and the UAS. (DJI-

1003, ¶192.) As discussed in §V.E.3, the combination of UTM-DNET and Butler discloses “*reporting, by the access point, a last vehicle status to the fleet controller*” [4B]. Thus, the D-NET system includes instructions for receiving messages from the ground station including a message with the last vehicle status from the ground station.

Accordingly, the D-NET system in the combination of UTM-DNET and Butler includes [“*the instructions for the monitoring operation of the vehicle include instructions for receiving,*”]/[“*the fleet controller is configured to receive,*”] “*from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection*” [10]/[17]. (DJI-1003, ¶¶191-93.)

7. Claim 12

The combination of UTM-DNET and Butler discloses “*the mission impact data comprises at least one of received event messages, traffic management system data, or exterior condition data*” for the reasons discussed *supra* §V.E.4.a for claim elements [5A]/[11A]/[18A]. (DJI-1003, ¶194.)

VI. Ground 2: Claims 6, 13, and 19 Are Obvious Over the Combination of UTM-DNET, Butler, and Bethke.

The combination of UTM-DNET and Butler discloses every limitation of independent claims 1, 8, and 15. However, the combination does not explicitly disclose “*determining whether the vehicle is subject to single source control*”

recited in claims 6, 13, and 19. The '972 patent provides limited details regarding “*single source control*.” At most, the '972 patent mentions an embodiment in which vehicle commands “may be sent to a control arbitrator, and in block 510, the control arbitrator may verify that the vehicle associated with the vehicle commands is subject to single source control.” (DJI-1001, 10:32-36.) After verifying the vehicle commands have proper authority or are a single source of control for the relevant vehicle, the vehicle commands “may be forwarded to the vehicle, in block 530 to control the vehicle.” (DJI-1001, 10:36-40.) Bethke discloses the subject matter of these claims.

A. Overview of the Combination

1. Bethke

Bethke teaches a “source determination system” that determines a control source to be in control of an unmanned aerial vehicle (UAV). (DJI-1007, Abstract, 12:7-10, 19:5-8.) Annotated Figure 3 below illustrates source determination system 200 (blue) that includes source priority engine 310 (shaded red) which receives “requests” (*i.e.*, “modular flight commands”) from one or more control sources. (DJI-1007, 19:11-14.) Source priority engine 310 uses priority information associated with each control source to determine which control source should be in control. (DJI-1007, 19:11-42; *see also*, 3:60-62, 12:10-19.) After determining a particular control source to be in control, source determination system 200

“provide[s] modular flight commands received from the particular control source to the [UAV’s] flight control system 220 to implement.” (DJI-1007, 12:19-22.)

Bethke discloses that its source determination system is “an application” executing on a computer system and is therefore software. (DJI-1007, 2:46-49; *see also*, DJI-1007, 11:46-48.)

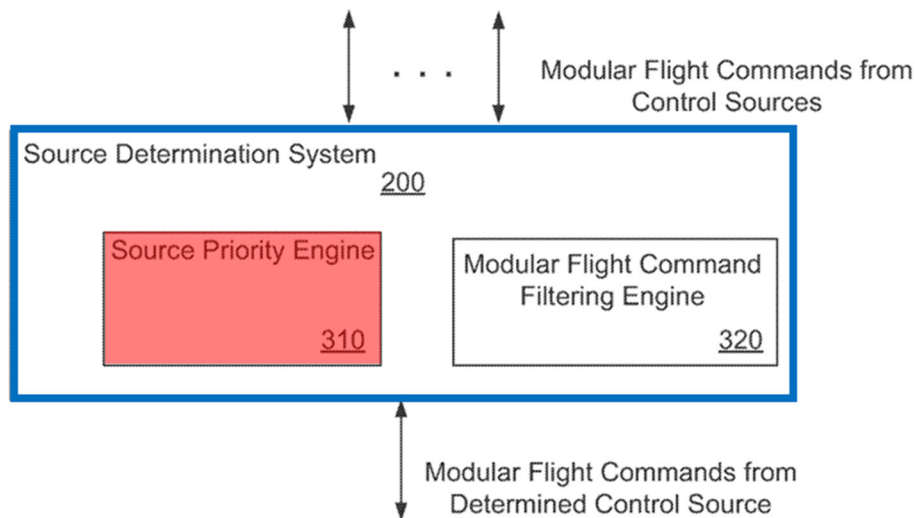
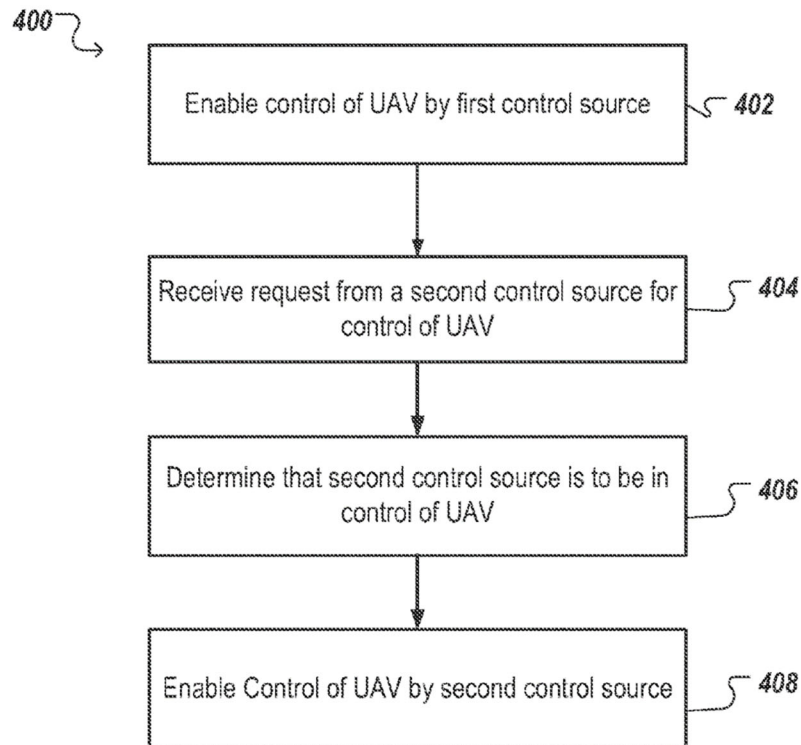


FIG. 3

Bethke, Figure 3.

Figure 4 below illustrates an example process 400 for enabling control of a UAV by a control source. (DJI-1007, 22:42-46.) At block 402, the system “enables control of a UAV by a first control source.” (DJI-1007, 22:47-53.) At block 404, the system “receives a request from a second control source for control of the UAV.” (DJI-1007, 22:54-59.) At block 406, the system determines that the second control source is to be in control of the UAV because the second control source is

associated with a higher priority than the first control source. (DJI-1007, 22:65-23:2.) At block 408, the system “interrupts control by the first control source and enables the second control source to provide modular flight commands [to the UAV] for implementation.” (DJI-1007, 22:3-23.)



Bethke, Figure 4.

2. Combination of UTM-DNET, Butler, and Bethke

A POSITA would have been motivated to incorporate Bethke’s teachings regarding source determination into the combined system of UTM-DNET and Butler. Specifically, a POSITA would have been motivated to include the source determination logic of Bethke in UAS ground station to determine whether the

vehicle is subject to single source control and to ensure the vehicle is subject to a single point of control at any one time. (DJI-1003, ¶¶199-210.)

A POSITA would have been motivated to combine Bethke with UTM-DNET and Butler as discussed above to avoid conflicting commands and reduce the risk of midair collision, particularly in disaster relief scenarios where visibility may be extremely limited. (DJI-1003, ¶200.) UTM-DNET suggests the combination, explaining that with disaster relief efforts, the aircraft involved in the coordinated effort belong to different organizations (e.g., military, fire departments, and medical services). (*See* DJI-1005, 2.) A POSITA would have understood that each of these organizations would have had the ability to issue commands to the aircraft in their fleet. (DJI-1003, ¶201.) Thus, a UAS through the ground station may receive commands from the D-NET system as well as the organization owning the UAS. (DJI-1003, ¶201.) Moreover, UTM-DNET discloses that each UAs may be assigned to a pilot who has the ability to assume control of the UAS and override a flight path executing on the UAS. (*See, e.g.*, DJI-1005, 13-14.)

A POSITA would have been motivated to provide the ability for multiple sources of control in a ground station to provide flexibility in the use scenario for a particular UAS. For example, a POSITA would have understood that a UAS owned by a fire department or medical service provided would benefit from the

capability of having a pilot override a programmed flight path to account for changing conditions. (DJI-1003, ¶202-03.) A POSITA would have also been motivated to include a prioritization of command sources to reflect hierarchy of control in various use cases. (DJI-1003, ¶204.) For example, a POSITA would understand that in disaster relief efforts, the D-NET system would be the highest priority source for commands whereas in a single fire or medical emergency, the fire department or medical agency would have priority. (DJI-1003, ¶¶204-05.) Finally, a POSITA would be motivated to ensure that the vehicle is subject to a single point of control at any one time in UTM-DNET disaster relief scenarios to limit the risk of collisions and to ensure optimization of the relief efforts. (DJI-1003, ¶206.)

The combination of UTM-DNET, Butler, and Bethke is simply the application of a known technique (Bethke's source determination functionality) to improve similar devices (the flight control system of UTM-DNET) in the same way. (DJI-1003, ¶207.) As discussed in §V.A, the combination of UTM-DNET and Butler includes a base UAS command and control system and the source determination functionality of Bethke would be viewed as an improvement to this system for the reasons discussed above. (DJI-1003, ¶207.) Bethke included a similar command and control system that was improved by the source determination functionality in the same way as in the combination. (DJI-1003,

¶208; DJI-1007, 2:34-37 (“the specification describes systems and methods for prioritizing control sources vying for command and control of an unmanned aerial vehicle (UAV) implementing a flight plan”).)

The results of the combination would have been predictable to a POSITA and the POSITA would have had a reasonable expectation of success in integrating Bethke’s teachings regarding source determination into the combined system of UTM-DNET and Butler. (DJI-1003, ¶209.) The source determination is implemented using software (e.g., an engine) that maintains priority information about one or more control sources, receives requests from the control sources, and determines a particular control source to be in control. (DJI-1007, 19:11-20; 29:5-53.) A POSITA would understand the UAS Ground Station to be implemented on a server that executes software instructions stored on a computer storage device. (DJI-1003, ¶210.) A POSITA would have thus been able and would have had an expectation of success in implementing Bethke’s source determination logic in the UAS Ground Station because the POSITA would have been familiar with computer programming. (DJI-1003, ¶211.)

B. Dependent Claims 6, 13, and 19

1. “Control arbitrator” [19A] and “single source control” [6A]/[13A]/[19B]

The combination of UTM-DNET, Butler, and Bethke discloses a “*control arbitrator*” that “*determin[es] whether the vehicle is subject to single source*

control, wherein [the] determining whether the vehicle is subject to single source control comprises ensuring that the vehicle is subject to a single point of control at any one time” [6A]/[13A]/[19B]. (DJI-1003, ¶¶213-17.)

In Bethke, the source determination functionality “determines a particular control source to be in control at any one time.” (DJI-1007, 12:7-10.) In the combination of UTM-DNET, Butler, and Bethke, in the use case of disaster relief efforts, this source determination functionality assigns highest priority to commands from the D-NET system and therefore determines the D-NET system to be the control source for all UAS command for the duration of the disaster relief efforts. (DJI-1003, ¶214.)

As discussed in §VI.A.2, in the combination of UTM-DNET, Butler, and Bethke, the source determination functionality is implemented in the UAS ground station as software. The source determination function is a “*control arbitrator*” [19A]. (DJI-1003, ¶216; *see also*, DJI-1001, 2:45-48, 9:36-41 (control arbitrator “ensure[s] a single point of control of a vehicle at any one time to prevent contradictory command or control from different users or sources,” for example by giving “command instructions with an emergency priority the highest priority, any non-emergency manual command the next highest priority, and any scheduled control instruction the lowest priority”).)

Thus, the combination of UTM-DNET, Butler, and Bethke discloses a “*control arbitrator*” (source determination functionality) [19A] that “*determin[es] whether the vehicle is subject to a single point of control at any one time*” by “*ensuring that the vehicle is subject to a single point of control at any one time*” [6A]/[13A]/[19B]. (DJI-1003, ¶¶213-17.)

2. “*Forward[ing] the vehicle commands*” [6B]/[13B]/[19C]

UTM-DNET discloses that flight plans verified by UTM are sent by the D-NET system “to the UAS ground base, which will convey it to the vehicle.” (DJI-1005, 8.) As discussed above, in the combination of UTM-DNET, Butler, and Bethke source determination functionality in the ground station “*ensur[es] that the vehicle is subject to a single point of control at any one time*” by assigning highest priority to UAS commands from the D-NET system during a disaster relief effort. Because the D-NET system is the single point of control during a disaster relief effort, the vehicle commands provided by the D-NET system to the ground station are conveyed to the vehicle rather than any conflicting commands received by the ground station. (DJI-1003, ¶219.) Thus, the combination of UTM-DNET, Butler, and Bethke discloses “*forward[ing] the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of*

vehicles commands associated with the vehicle” [6B]/[13B]/[19C]. (DJI-1003, ¶¶218-20.)

VII. Discretionary Denial is Not Appropriate

A. 35 U.S.C. §325(d)

Discretionary denial under 35 U.S.C. § 325(d) is not appropriate in this proceeding. None of the prior art grounds in this Petition were considered or evaluated by the Patent Office during prosecution. Mullan is the only reference applied during prosecution. (See DJI-1002, 176-90.) Furthermore, the Petition’s grounds teach “*identifying a flight path associated with the mission*”; “*verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path*”; and “*modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified*”; the features added by PO to obtain allowance of the ’972 patent. (See DJI-1002, 207-14, 278-80.) The Petition’s grounds are therefore not cumulative to the grounds considered during prosecution. For these reasons, the first part of the *Advanced Bionics* framework is not satisfied. *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential).

Moreover, the Examiner did not have the benefit of Petitioner's Expert, Dr. Charles Reinholtz, and the supported extrinsic evidence, submitted herewith. Thus, there is no (or very minimal) overlap between arguments made during examination and the manner in which Petitioner relies on the prior art because no arguments were made on the record related to UTM-DNET, Butler, and/or Bethke. Therefore, even if the second part of the *Advanced Bionics* framework is considered, the evidence and facts presented in the Petition warrant consideration by the Office. *Advanced Bionics*, 9-11.

B. 35 U.S.C. §314(a)

The Board should reach the merits in this proceeding because the Petition presents a compelling unpatentability challenge. (*See* Interim Procedure for Discretionary Denials, 4-5.) As set forth herein, the evidence presented in this Petition, "if unrebutted in trial, would plainly lead to a conclusion that one or more claims are unpatentable by a preponderance of the evidence." (Interim Procedure, 4.) The purported novelty of the '972 patent is the use of a UTM to control a fleet of autonomous vehicles. However, systems and methods for controlling autonomous vehicle fleets, including in particular NASA's sophisticated UTM system, were well-known long before the '972 patent, as Petitioner establishes above. (*See* DJI-1003, ¶¶26-44.)

Should PO raise discretionary denial under *Fintiv* in its preliminary response, Petitioner reserves the right to offer a stipulation at that time to mitigate or foreclose *Fintiv* discretionary denial.

VIII. Mandatory Notices (37 C.F.R. §42.8(B))

A. Real Parties-in-Interest

The real parties-in-interest are DJI Europe B.V. (Petitioner), SZ DJI Technology Co., Ltd., DJI Technology, Inc., iFlight Technology Company Limited, SZ DJI Baiwang Technology Co. Ltd., and DJI Research LLC.

B. Related Matters

To the best of DJI's knowledge, the '972 patent is involved in the following pending district court litigation: *Textron Innovations Inc. v. SZ DJI Tech. Co., Ltd.*, Civil Action No. 2:22-cv-00351 (E.D. Tex. Sept. 9, 2022).

C. Notice of Counsel and Service Information

Pursuant to 37 C.F.R. §§42.8(b)(3), 42.8(b)(4) and 42.10(a), Petitioner appoints **Lori A. Gordon** (Reg. No. 50,633) at the address of Perkins Coie LLP, 700 Thirteenth Street, N.W., Suite 800, Washington, DC 2005-3960, phone number 202-654-6200, as its lead counsel; and **Zane Bi** (Reg. No. 79,130) at the above address, as its backup counsel.

Petitioner consents to electronic service by email at the email addresses: gordon-ptab@perkinscoie.com and bi-ptab@perkinscoie.com.

IX. Conclusion

Inter partes review of the claims is respectfully requested.

Respectfully submitted,

/Lori A. Gordon/

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Date: August 15, 2023

CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(d)

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *Inter Partes* Review of U.S. Patent No. 11,288,972, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,629. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

/Lori A. Gordon/

Lori A. Gordon
Attorney for Petitioner

Date: August 15, 2023

CERTIFICATE OF SERVICE

The undersigned certifies that true copies of the Petition for *Inter Partes* Review of U.S. Patent No. 11,288,972 and supporting materials were served via overnight delivery on the Patent Owner at the correspondence address of record as listed on PAIR:

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/Lori A. Gordon/

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Attorney for Petitioner

Date: August 15, 2023

CLAIM APPENDIX

Independent Claim 1

- [1P] An autonomous vehicle fleet control method, comprising:
 - [1A] obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;
 - [1B] identifying a flight path associated with the mission;
 - [1C] verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM),
 - [1C.1] wherein the UTM performs checking on the flight path for traffic in the flight path,
 - [1C.2] availability of the flight path due to flight restrictions
 - [1C.3] and requirements for use of the flight path;
 - [1D] modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;
 - [1E] generating vehicle commands according to mission parameters associated with the mission based on the flight path;
 - [1F] maintaining a persistent connection with the vehicle;

- [1G] sending the vehicle commands to the vehicle using the connection,
the vehicle commands causing the vehicle to execute the mission
under control of the fleet controller; and
- [1H] monitoring operation of the vehicle during performance of the
mission.

Independent Claim 8

- [8P] A fleet controller for controlling an autonomous vehicle fleet,
comprising:
 - [8A] a processor; and
 - [8B] a non-transitory computer-readable storage medium storing a
program to be executed by the processor, the program including
instructions for:
 - [8C] obtaining, from a master schedule, a mission for a vehicle of a fleet
of autonomous vehicles, wherein the mission is associated with a
mission entry of the master schedule;
 - [8D] identifying a flight path associated with the mission;
 - [8E] verifying a usability of the flight path with a unmanned aircraft
system (UAS) traffic management (UTM),
 - [8E.1] wherein the UTM performs checking on the flight path for traffic in
the flight path,

- [8E.2] availability of the flight path due to flight restrictions and
- [8E.3] requirements for use of the flight path;
- [8F] modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;
- [8G] generating vehicle commands according to mission parameters associated with the mission based on the flight path;
- [8H] maintaining a persistent connection with the vehicle through a communications network;
- [8I] sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and
- [8J] monitoring operation of the vehicle during performance of the mission.

Independent Claim 15

- [15P] An autonomous vehicle fleet control system, comprising:
 - [15A] a vehicle;
 - [15B] a communications network; and
 - [15C] a fleet controller in communication with the vehicle by way of the communications network, the fleet controller configured to:

- [15D] obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;
- [15E] identify a flight path associated with the mission;
- [15F] verify a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM),
 - [15F.1] wherein the UTM performs checking on the flight path for traffic in the flight path,
 - [15F.2] availability of the flight path due to flight restrictions and
 - [15F.3] requirements for use of the flight path;
- [15G] modify the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;
- [15H] generate vehicle commands according to mission parameters associated with the mission based on the flight path;
- [15I] maintain a persistent connection with the vehicle through the communications network;
- [15J] send the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle commands; and

[15K] monitor operation of the vehicle during performance of the mission.