

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
15 July 2021 (15.07.2021)



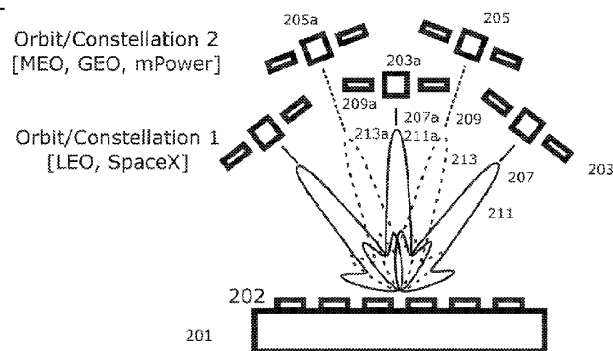
(10) International Publication Number
WO 2021/140451 A1

- (51) **International Patent Classification:**
G01S 3/38 (2006.01) *G01S 3/74* (2006.01)
- (21) **International Application Number:**
PCT/IB2021/050078
- (22) **International Filing Date:**
06 January 2021 (06.01.2021)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
62/958,043 07 January 2020 (07.01.2020) US
16/854,442 21 April 2020 (21.04.2020) US
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- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** NON-COOPERATIVE POSITION, NAVIGATION, AND TIMING EXTRACTION FROM VSAT COMMUNICATIONS SIGNALS USING MULTI-BEAM PHASED ARRAY ANTENNA

Figure 2



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(57) **Abstract:** A ground antenna determines the current time and its own position from received signals that were transmitted by artificial earth satellites for communication. A high-gain multi-beam electrically-steered antenna is combined with a processing system to measure the angles between two or more satellites and determine the present distance to each satellite by the information broadcast on the TT&C channel. The knowledge of the angles and distances, as well as the trajectory of the satellites, can be combined with their locations as predicted by the satellite ephemeris data to triangulate the location of the receiver. This system is different from conventional GPS antennas because it does not require the cooperation of active communication with the satellites to derive a location estimate. The location is computed by the ground terminal, not by the satellite. This system can be used in cases where other locating services are offline, jammed, or otherwise unavailable to maintain location and time synchronization.

[Continued on next page]

Published:

- with international search report (Art. 21(3))
- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE