

FIG.1

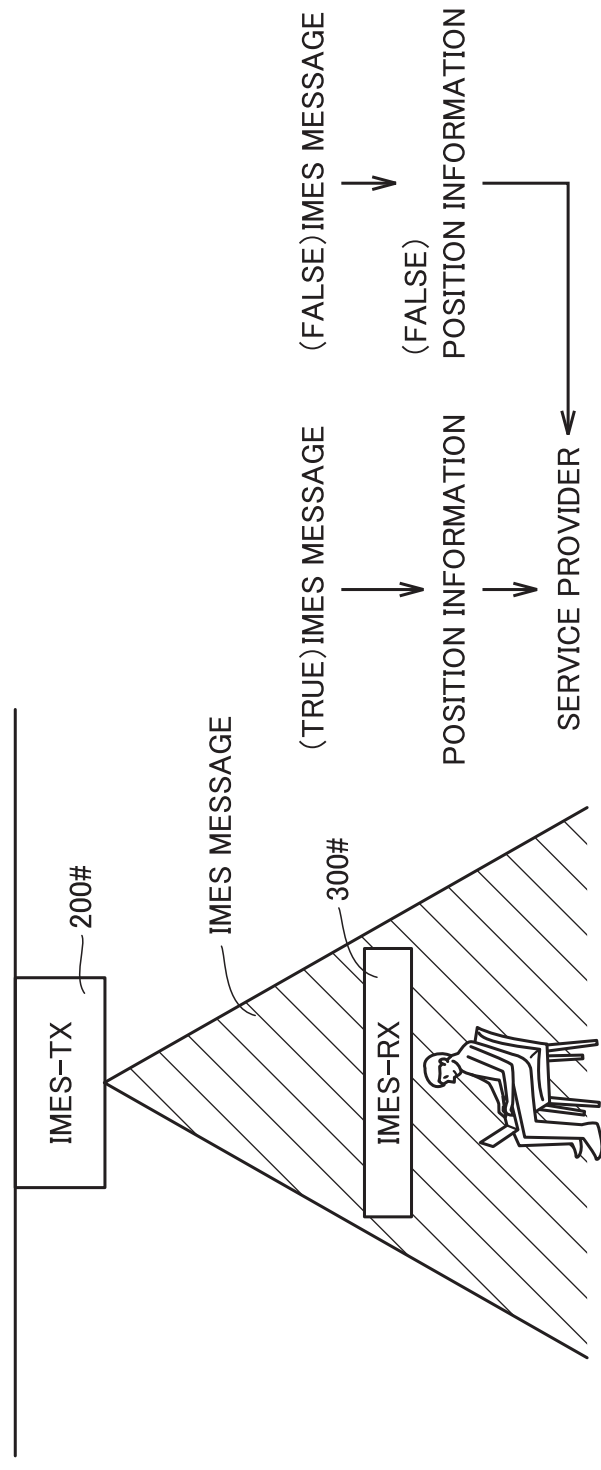


FIG.2

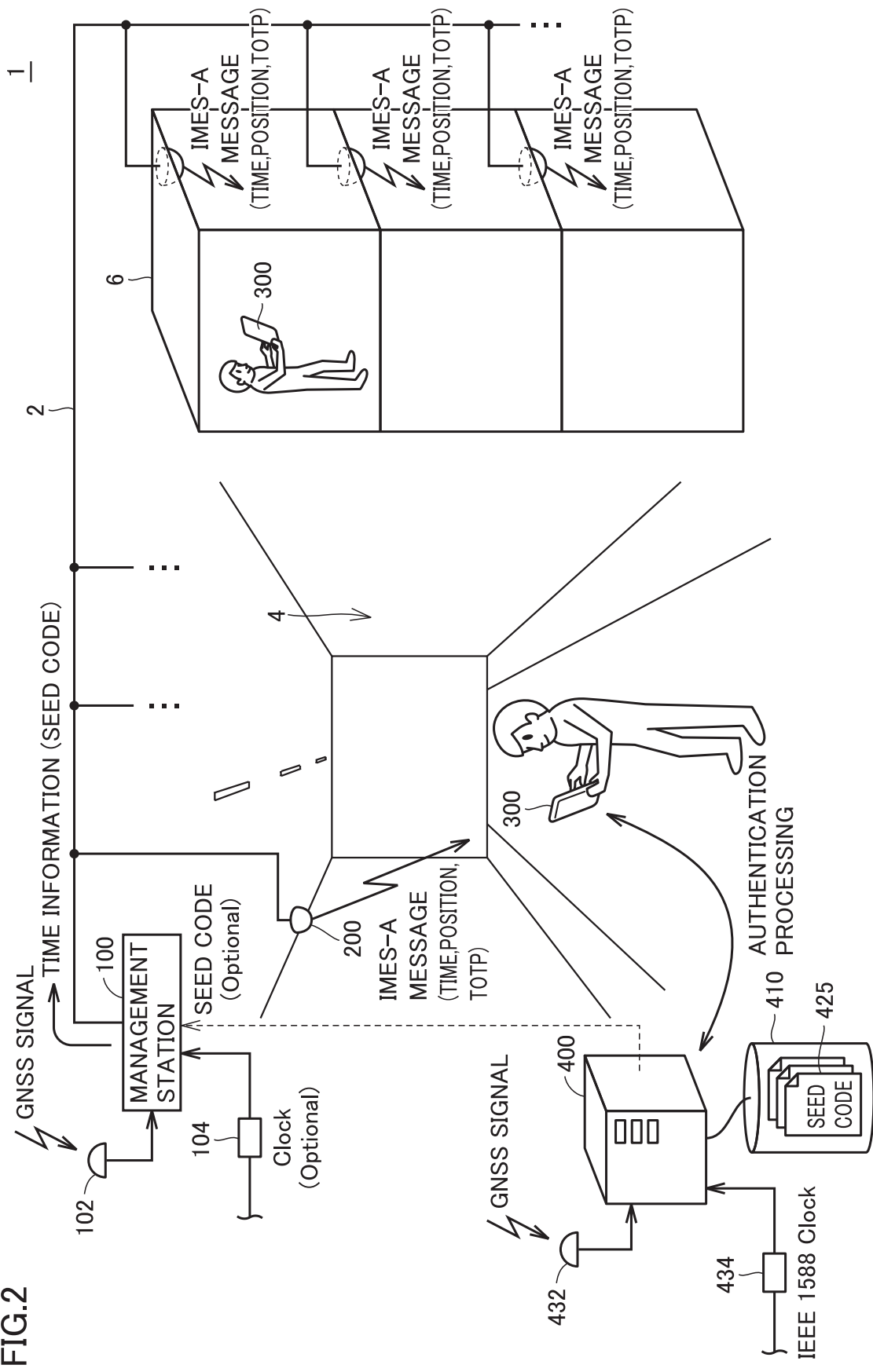


FIG.3

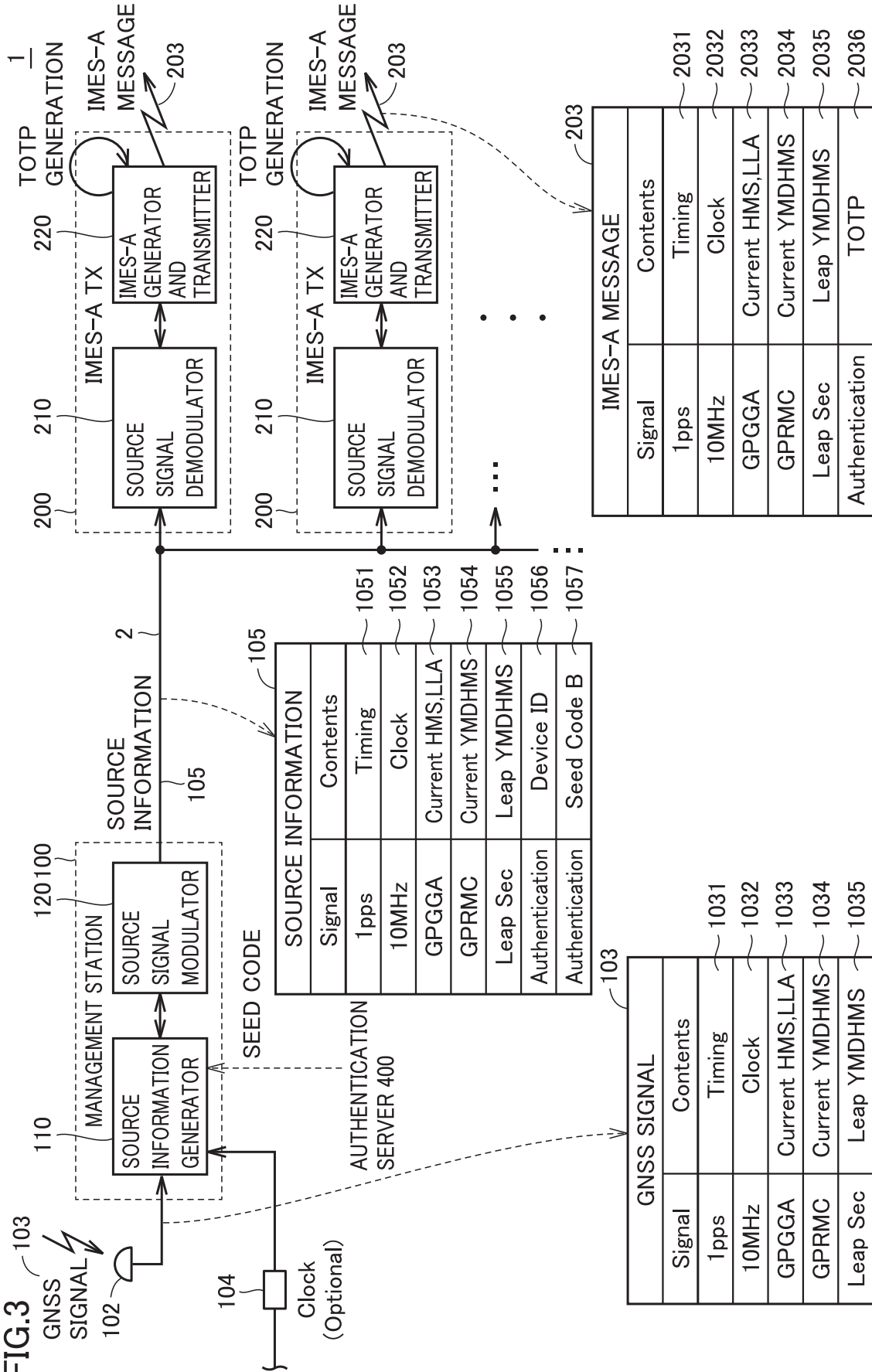


FIG.4

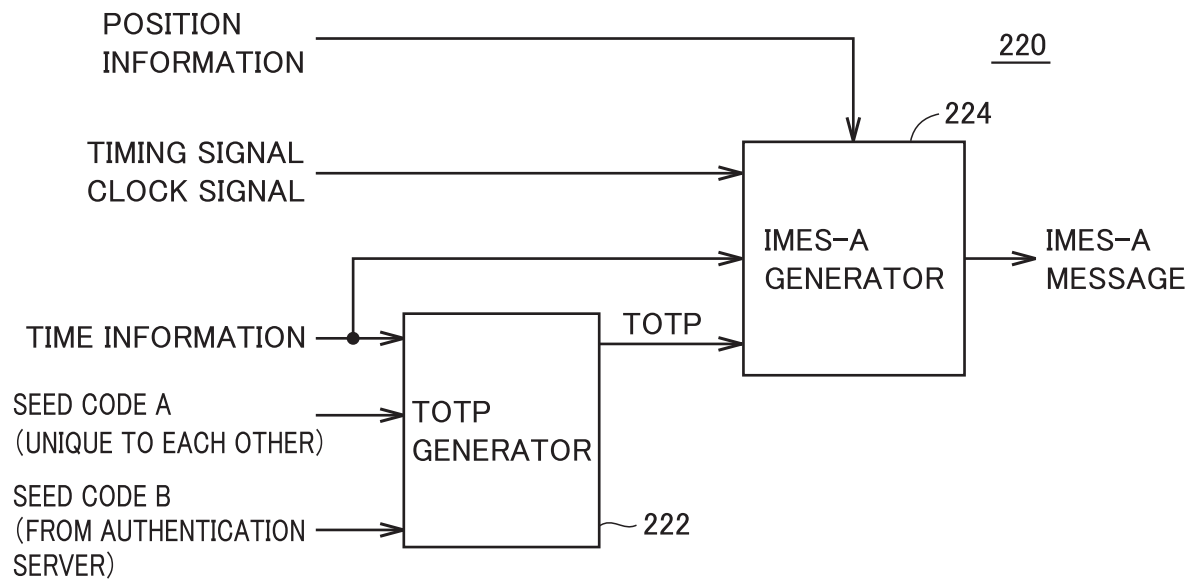


FIG.5

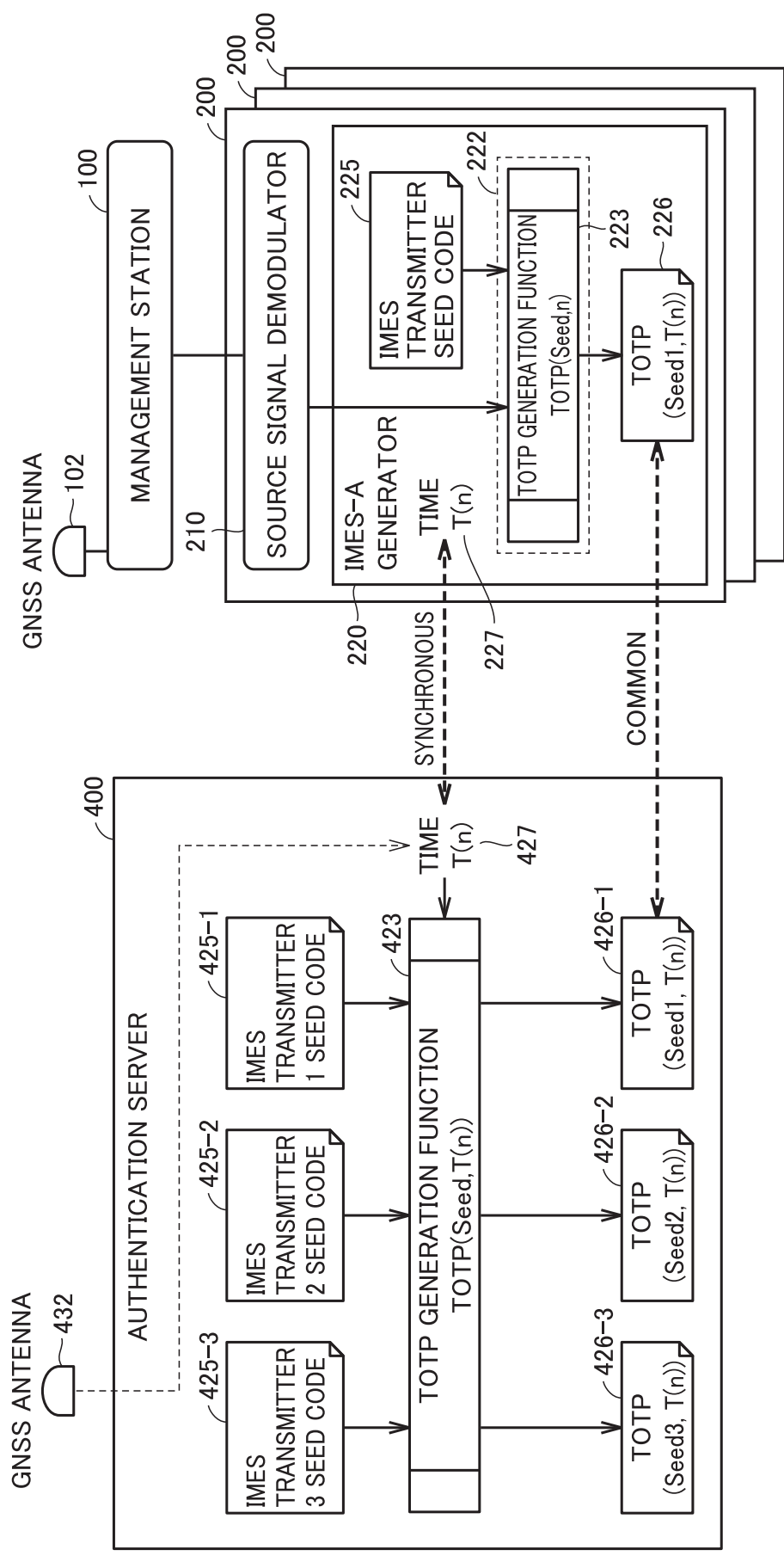


FIG.6

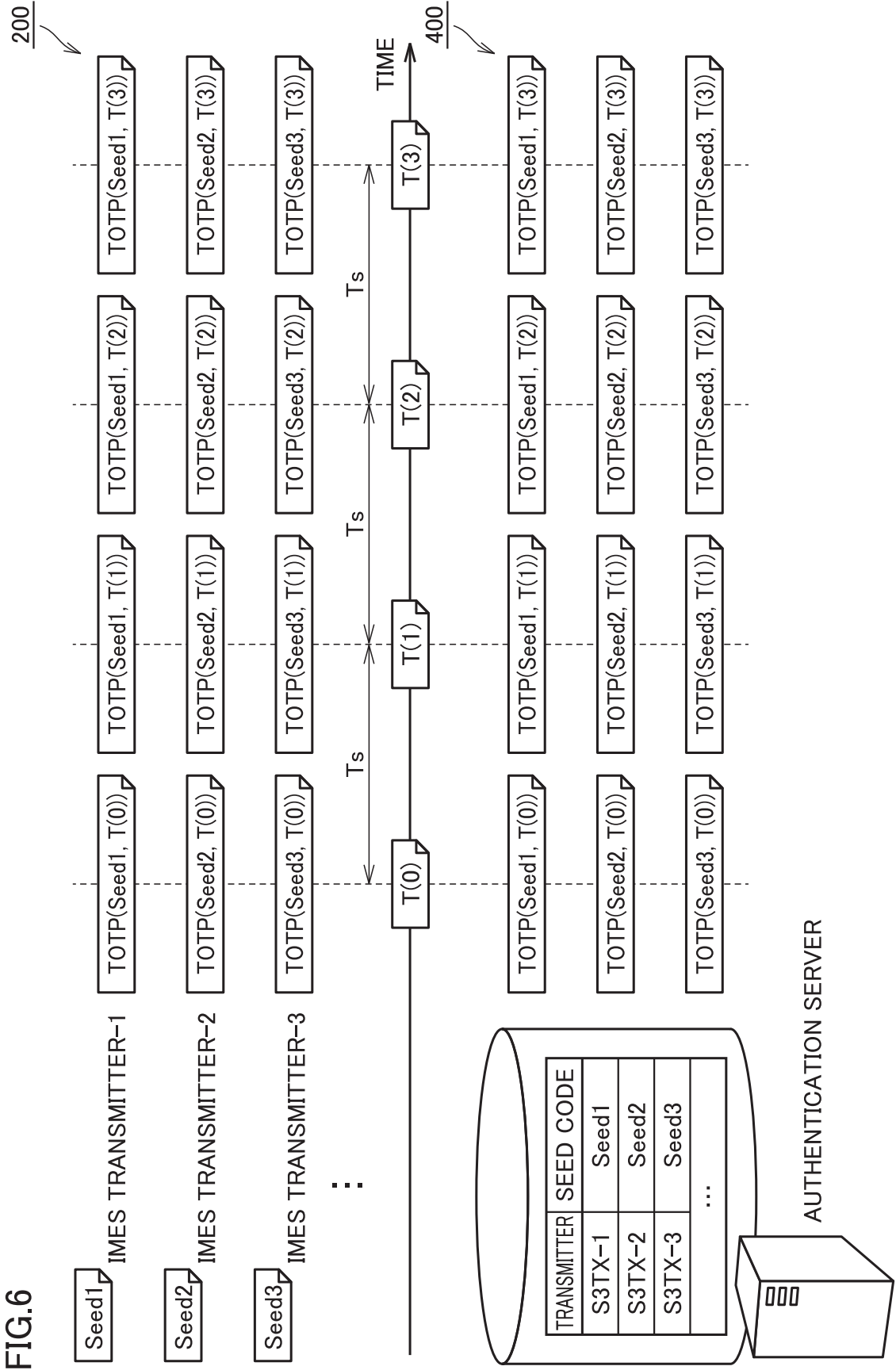


FIG.7

| MESSAGE TYPE | PAGE COUNT | NAME                   | THE NUMBER OF WORDS | LOWEST FREQUENCY | CONTENT (LSB)                                             |
|--------------|------------|------------------------|---------------------|------------------|-----------------------------------------------------------|
| MT0 000      | N/A        | POSITION INFORMATION 1 | 3                   | 12               | LATITUDE・LONGITUDE(2.4m), FLOOR NUMBER(1)                 |
| MT1 001      | N/A        | POSITION INFORMATION 2 | 4                   | 12               | LATITUDE・LONGITUDE(1.2m), ALTITUDE(1m), FLOOR NUMBER(0.5) |
| MT3 011      | N/A        | SHORT ID               | 1                   | 6                | 12-BIT ID                                                 |
| MT4 100      | N/A        | MEDIUM ID              | 2                   | 12               | 33-BIT ID                                                 |
| MT7 110      | 1-3        | TAS                    | 4                   | -                | TIME/AUTHENTICATION TO TP (RFC6238)                       |

270

IMES MESSAGE

IMES-A MESSAGE

FIG.8

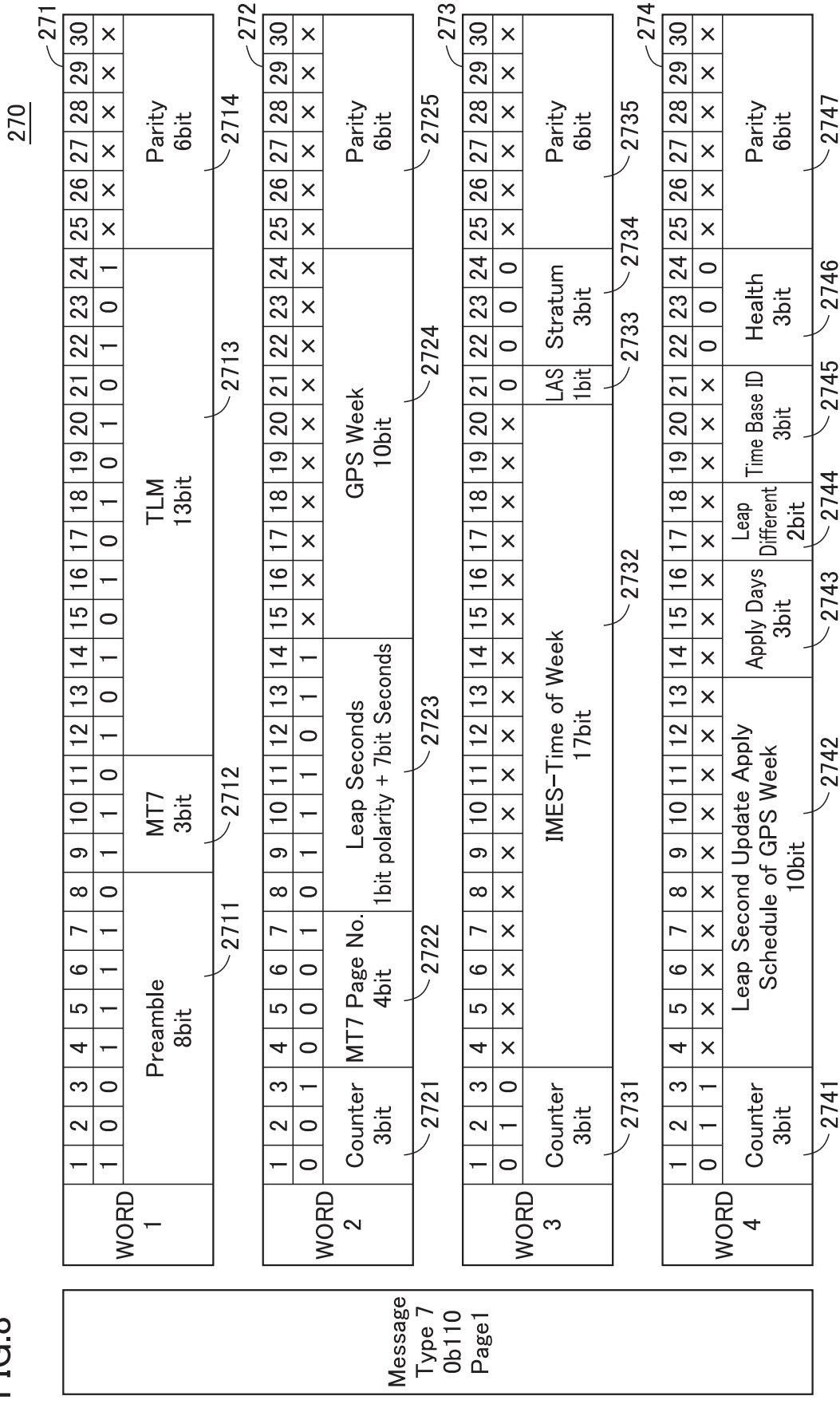


FIG.9

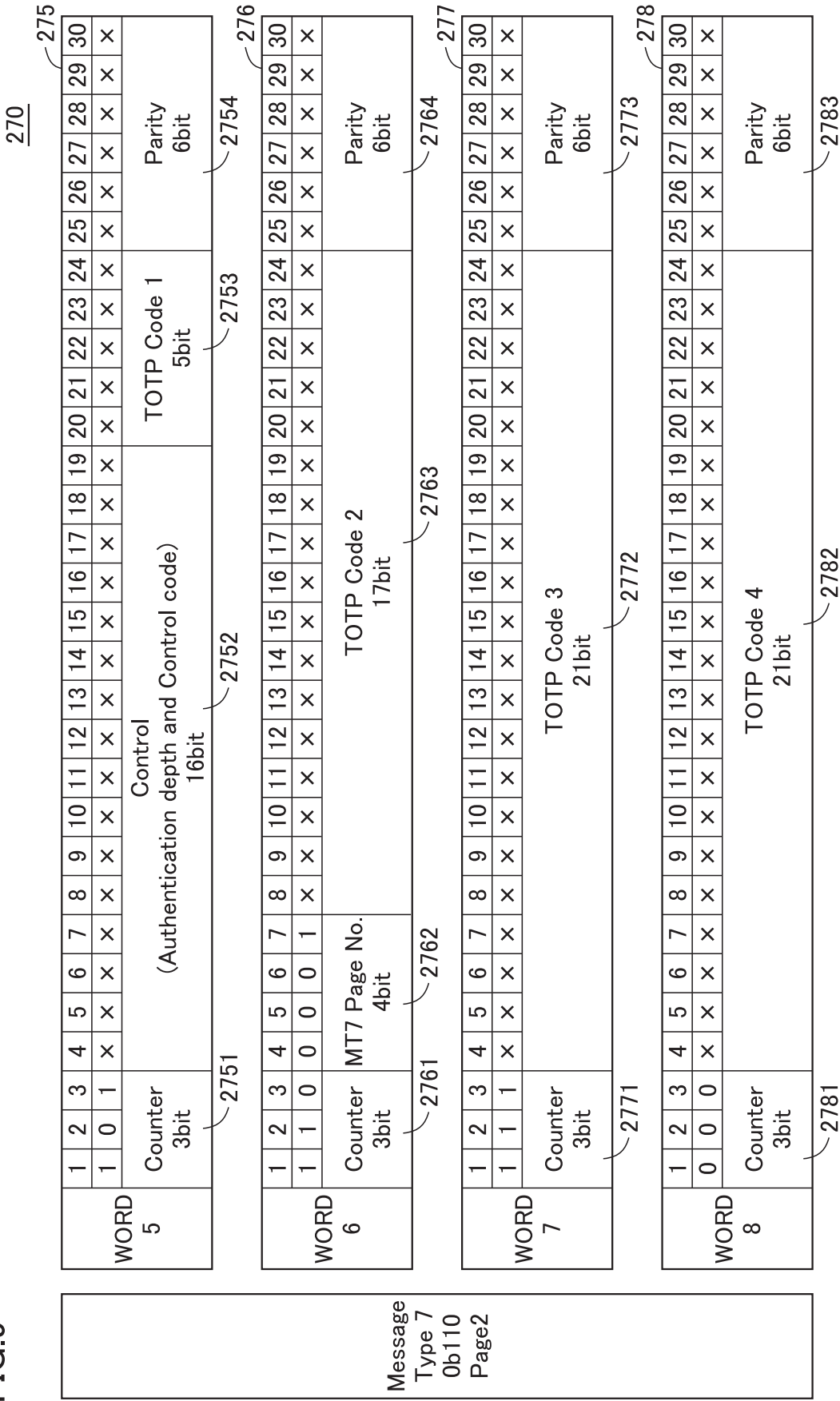


FIG.10

| [ IMASC ] Authentication Service Code Message |                             |                                                                  |                                                                                                                                                                                                                           |  |
|-----------------------------------------------|-----------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| No.                                           | Sentence Description        | Format                                                           | Notes                                                                                                                                                                                                                     |  |
| 1                                             | Header                      | \$                                                               | Fixed character.                                                                                                                                                                                                          |  |
| 2                                             | Talker ID                   | IM                                                               | Fixed character.                                                                                                                                                                                                          |  |
| 3                                             | Sentence ID                 | ASC                                                              | Kind of data.                                                                                                                                                                                                             |  |
| 4                                             | Refer PRN channel           | Integer Value                                                    | Refer IMES-TAS signal PRN No.                                                                                                                                                                                             |  |
| 5                                             | ASC Version                 | Integer Value                                                    | Management number for security weakness. 0 = default Other numbers are reserved.                                                                                                                                          |  |
| 6                                             | Current IMES-GPS Week       | Integer Value In decimal                                         | It is supplied by IMES management network. This value is broadcasted by IMES transmitter.                                                                                                                                 |  |
| 7                                             | Current IMES-TOW            | Integer Value In decimal                                         | It is supplied by IMES management network. This value is broadcasted by IMES transmitter.                                                                                                                                 |  |
| 8                                             | Status                      | Integer Value                                                    | 0 = Invalid, Do not use.<br>1 = Valid<br>2 to 9 = Reserved                                                                                                                                                                |  |
| 9                                             | C/No                        | Integer Value                                                    | 00 – 99 [dB-Hz]                                                                                                                                                                                                           |  |
| 10                                            | Latitude                    | ddmm.mmmmmm                                                      | Latitude in IMES Message                                                                                                                                                                                                  |  |
| 11                                            | N/S indicator               | Character                                                        | N = North, S = South                                                                                                                                                                                                      |  |
| 12                                            | Longitude                   | dddmm.mmmmmm                                                     | Longitude in IMES Message                                                                                                                                                                                                 |  |
| 13                                            | E/W Indicator               | Character                                                        | E = East, W = West                                                                                                                                                                                                        |  |
| 14                                            | Altitude                    | hh.hh                                                            | Altitude in IMES Message                                                                                                                                                                                                  |  |
| 15                                            | Altitude Unit               | Character                                                        | M = Meter                                                                                                                                                                                                                 |  |
| 16                                            | Floor ID                    | Floating value                                                   | Floor ID in IMES Message                                                                                                                                                                                                  |  |
| 17                                            | TOTP Control Code           | Hex16bit.<br>It is expressed in ASCII characters.                | 16bit possible values 0x0000 to 0xFFFF                                                                                                                                                                                    |  |
| 18                                            | TOTP Value                  | Hex 64bit or Hex 128bit.<br>It is expressed in ASCII characters. | 64bit possible values 0x0000 0000 0000 0000 to 0xFFFF FFFF FFFF FFFF<br>128bit possible values 0x0000 0000 0000 0000 0000 0000 0000 0000 to 0xFFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF<br>*128bit length TOTP is reserved. |  |
| 19                                            | Time Base ID                | Integer Value                                                    | ID of the time delivery station.                                                                                                                                                                                          |  |
| 20                                            | Checksum                    | *CS                                                              | As per NMEA Standard.                                                                                                                                                                                                     |  |
| 21                                            | Carriage Return & Line Feed | <CR><LF>                                                         |                                                                                                                                                                                                                           |  |

FIG.11

300

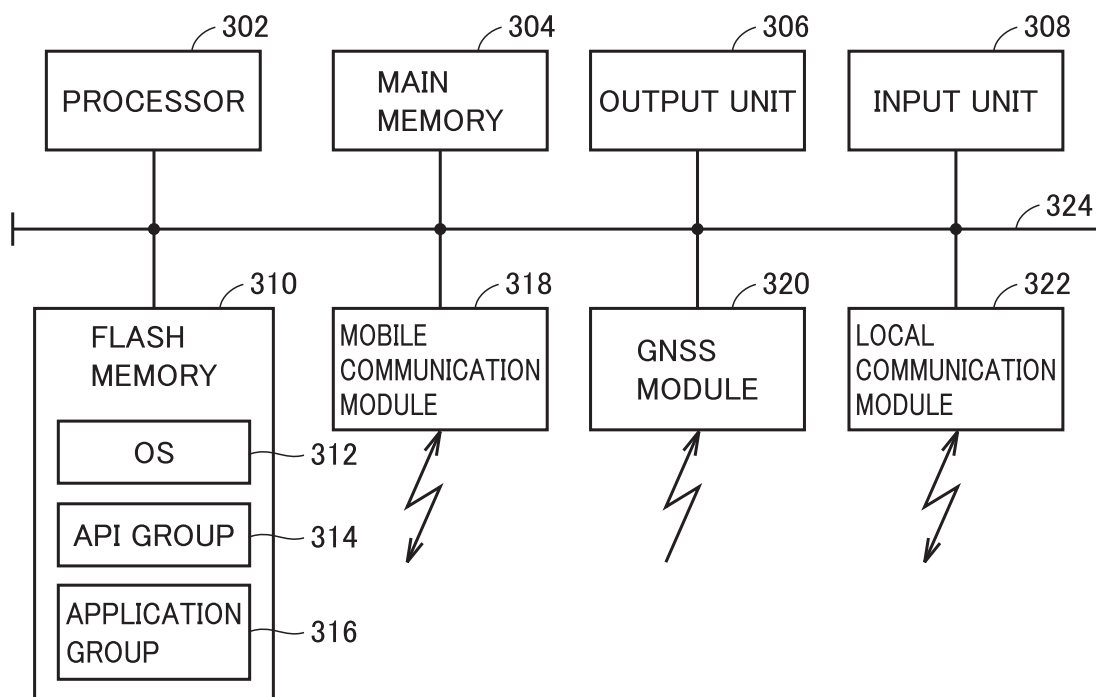


FIG.12

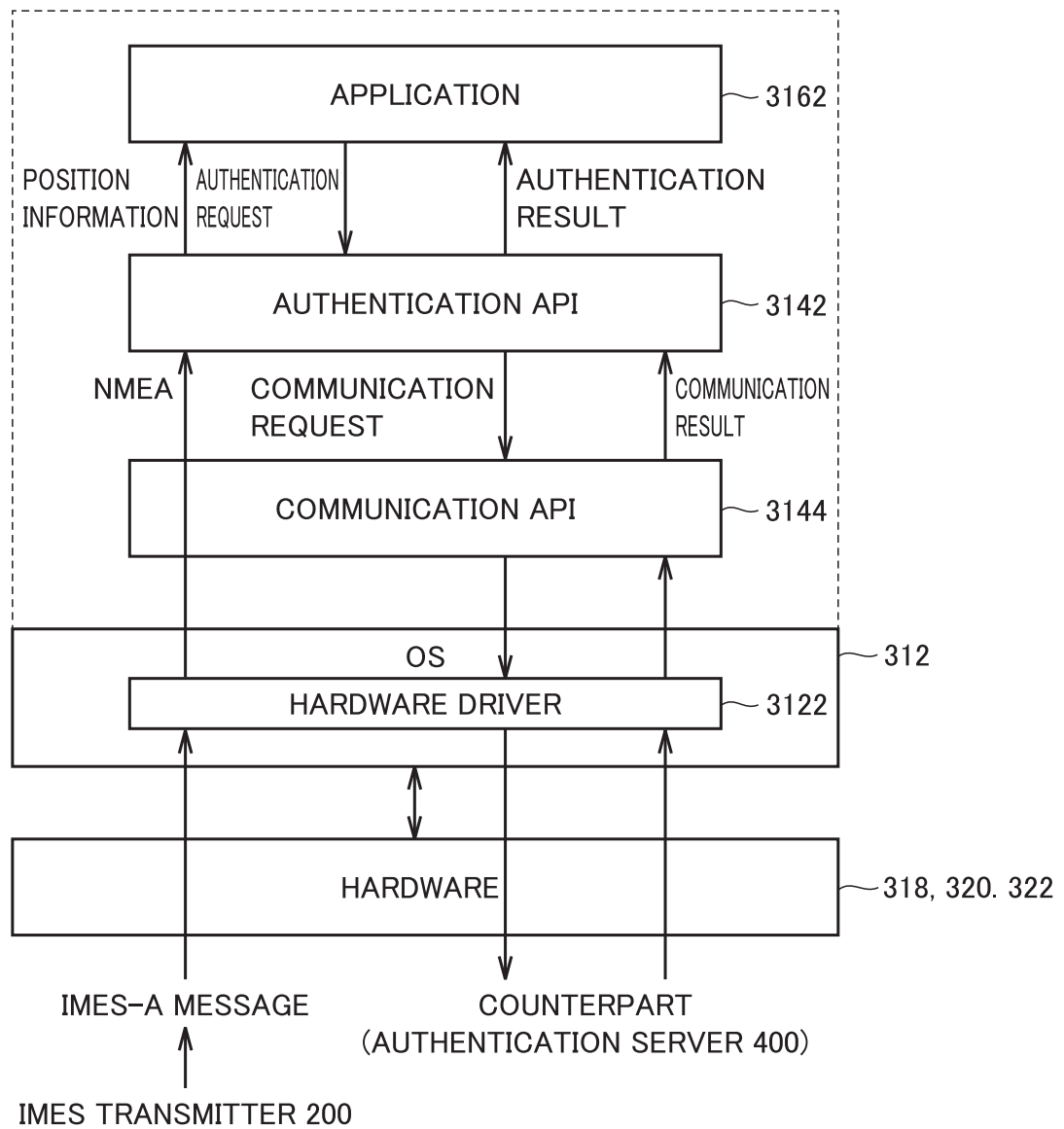


FIG.13

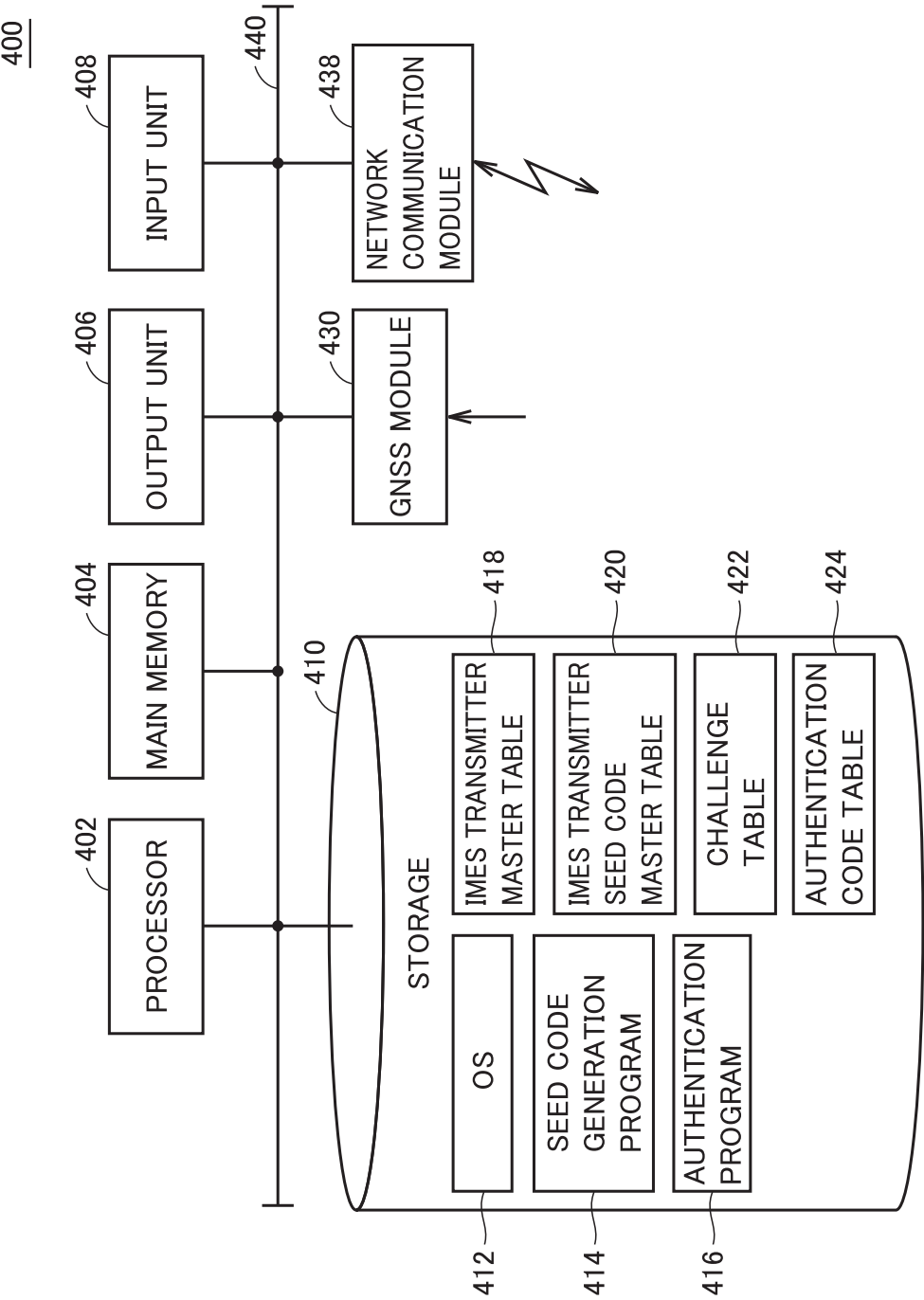
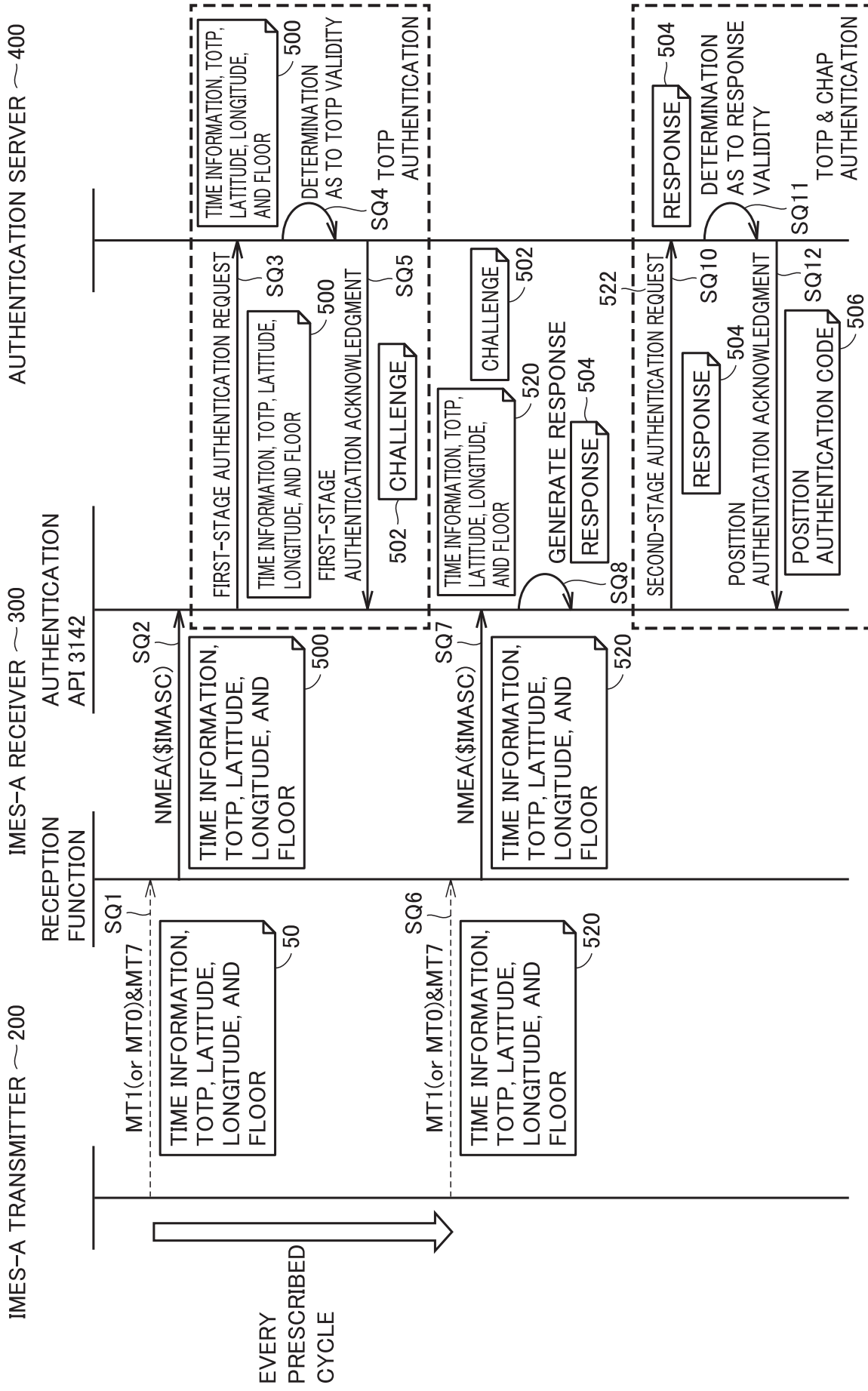
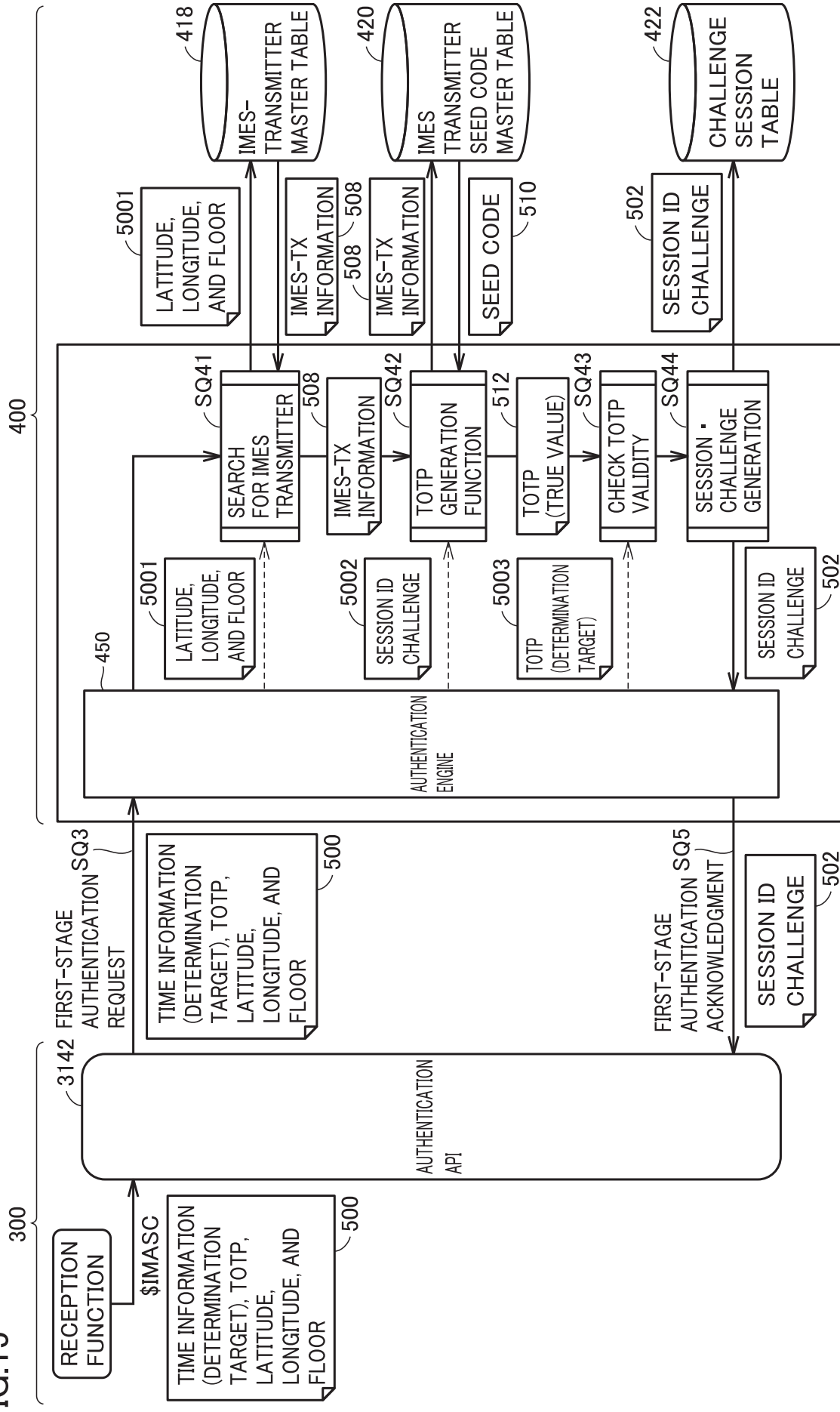


FIG.14



**FIG. 15**



**FIG. 16**

The diagram illustrates a system architecture for authentication, divided into three main functional areas: 300, 400, and 500.

**Area 300: RECEPTION FUNCTION**

- 3142: GENERATE RESPONSE (Challenge, TOTP)
- 504: RESPONSE
- 520: TIME INFORMATION, TOTP, LATITUDE, LONGITUDE, AND FLOOR
- 522: SESSION ID, TIME INFORMATION, RESPONSE (DETERMINATION TARGET), LATITUDE, LONGITUDE, AND FLOOR
- 506: AUTHENTICATION CODE

**Area 400: AUTHENTICATION ENGINE**

- 418: IMES-TRANSMITTER MASTER TABLE
- 420: IMES-TRANSMITTER SEED CODE MASTER TABLE
- 422: CHALLENGE SESSION TABLE
- 424: AUTHENTICATION CODE TABLE
- 528: IMES-TX INFORMATION
- 530: SEED CODE
- 532: TOTP
- 534: RESPONSE (TRUE VALUE)
- 536: AUTHENTICATION CODE, TIME INFORMATION, LATITUDE, LONGITUDE, AND FLOOR
- 538: CHALLENGE
- 540: AUTHENTICATION CODE

**Area 500: POSITION AUTHENTICATION ACKNOWLEDGMENT**

- 502: SESSION ID CHALLENGE
- 504: RESPONSE
- 506: AUTHENTICATION CODE

**Flow and Data Flow:**

- 3142 sends SQ81 to 418.
- 418 sends SQ111 to 528.
- 528 sends SQ112 to 420.
- 420 sends SQ113 to 422.
- 422 sends SQ114 to 534.
- 534 sends SQ115 to 424.
- 424 sends SQ12 to 506.
- 506 sends SQ10 to 522.
- 522 sends SQ82 to 418.
- 418 sends SQ111 to 528.
- 528 sends SQ112 to 420.
- 420 sends SQ113 to 422.
- 422 sends SQ114 to 534.
- 534 sends SQ115 to 424.
- 424 sends SQ12 to 506.
- 506 sends SQ10 to 522.
- 522 sends SQ82 to 418.

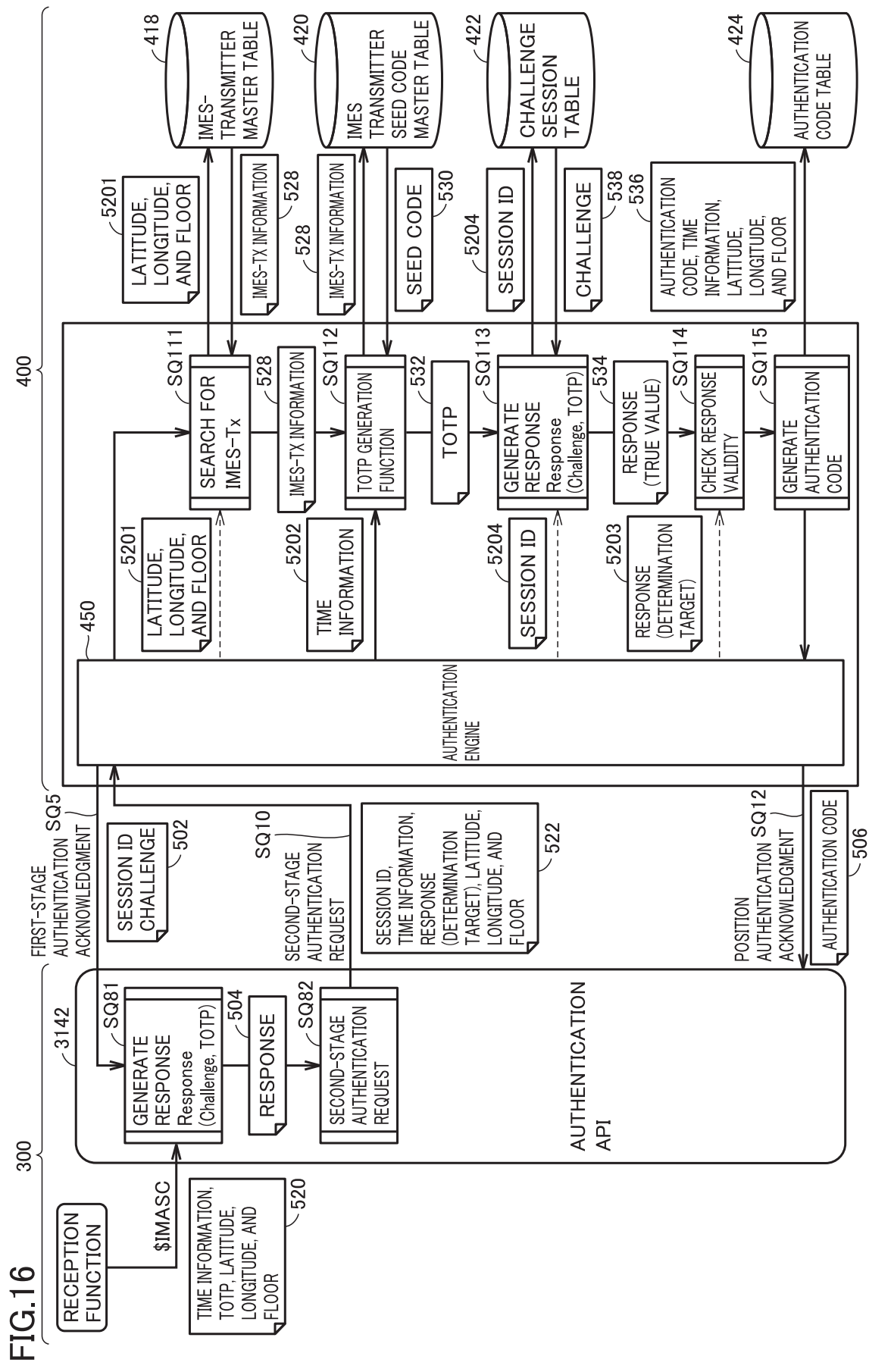


FIG.17

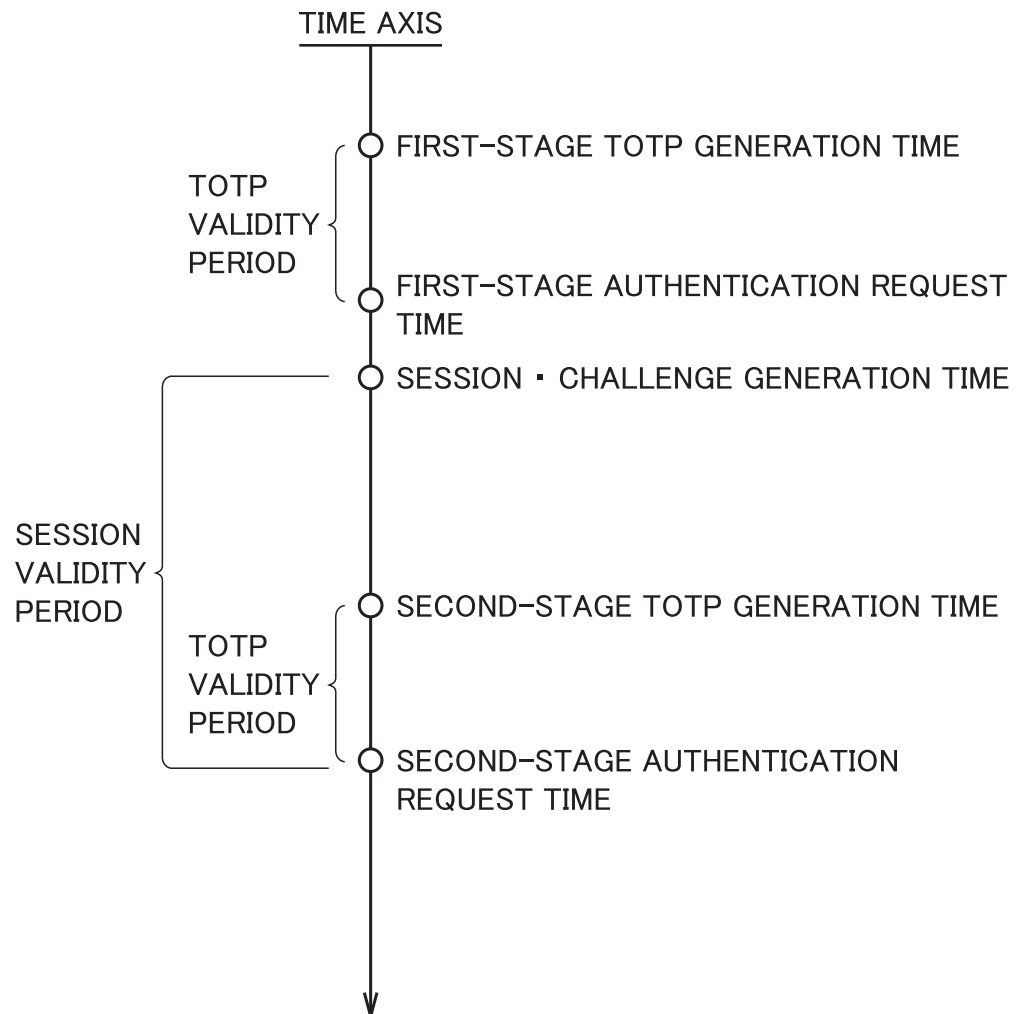


FIG.18

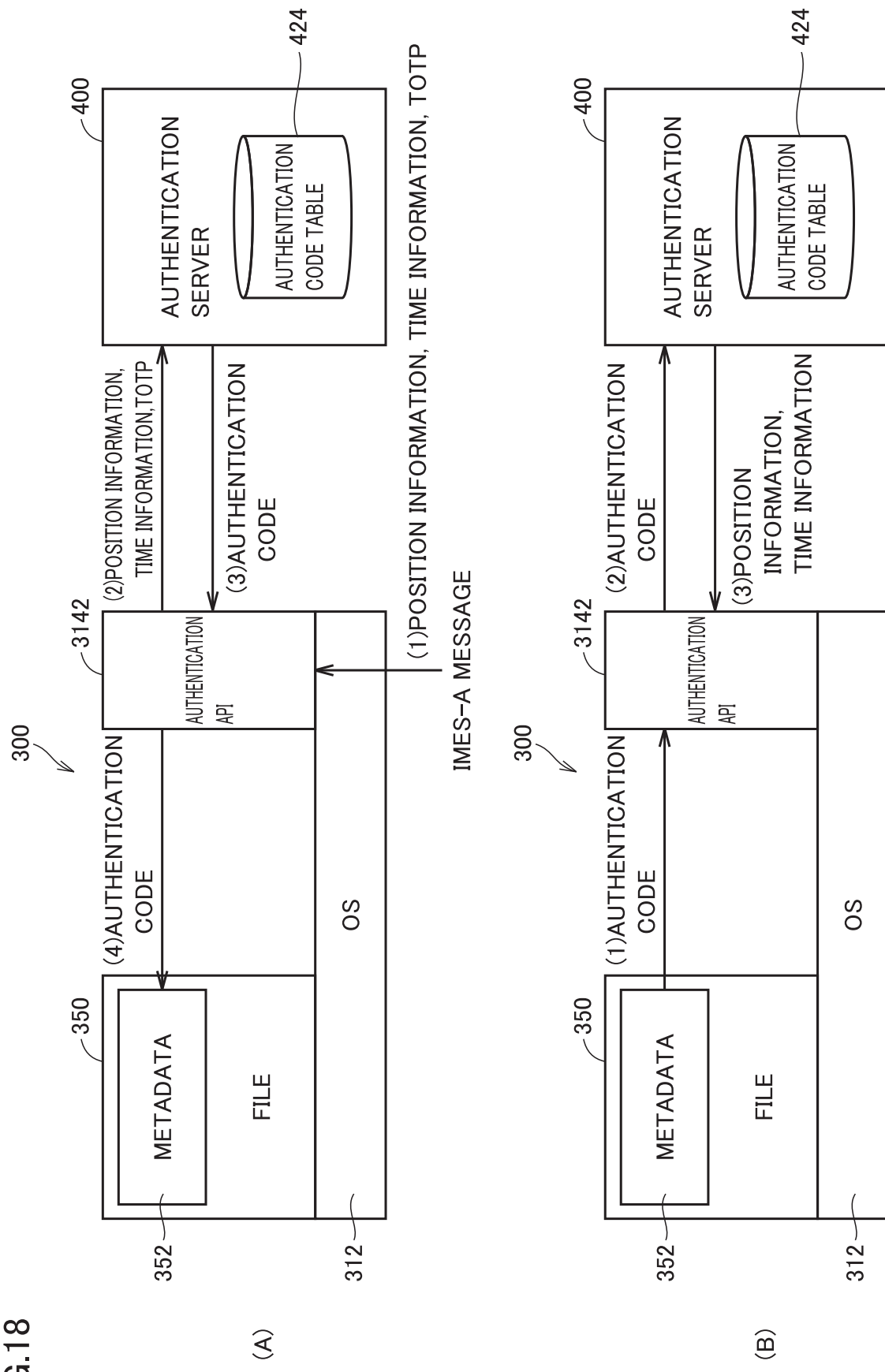


FIG.19

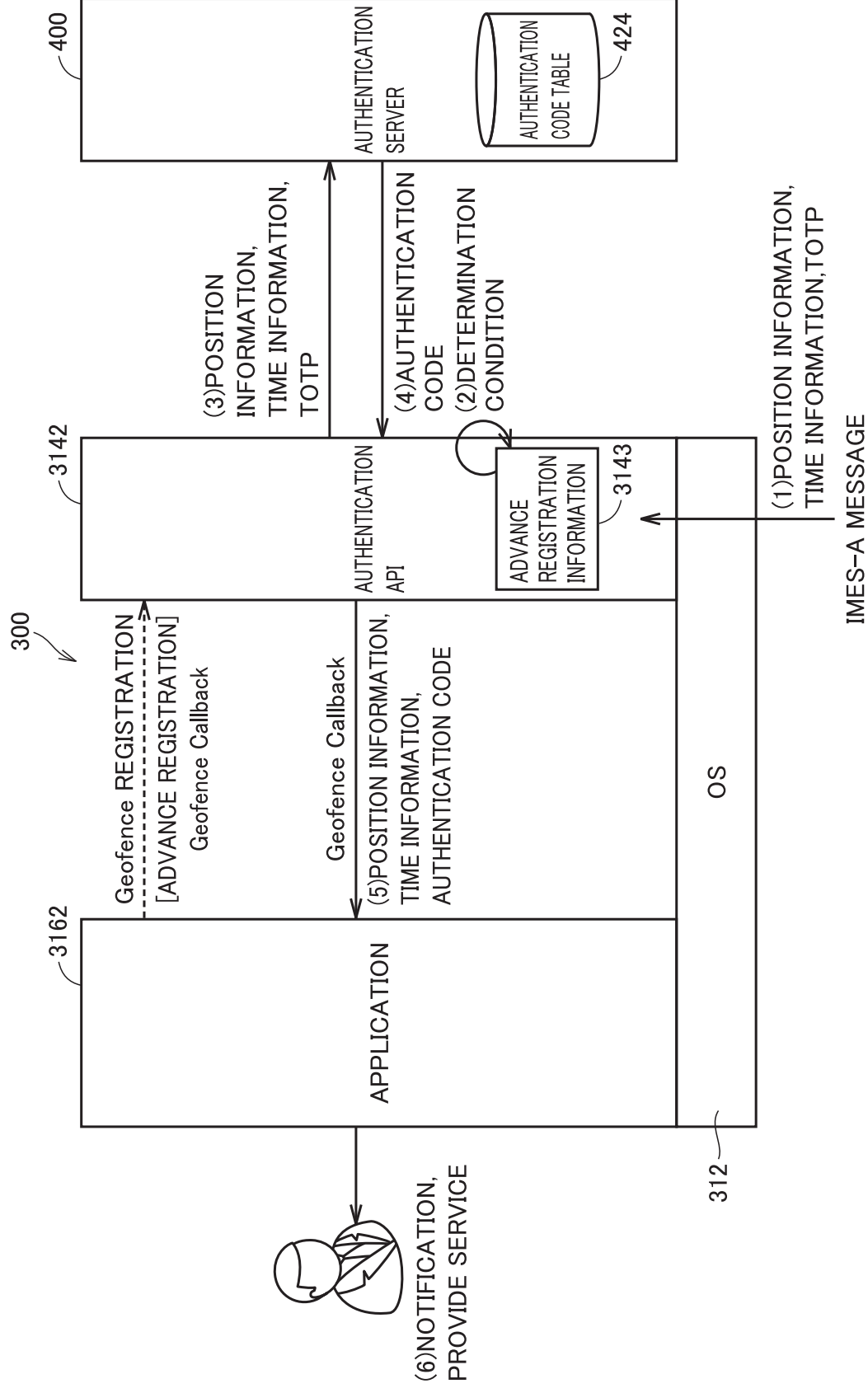


FIG.20

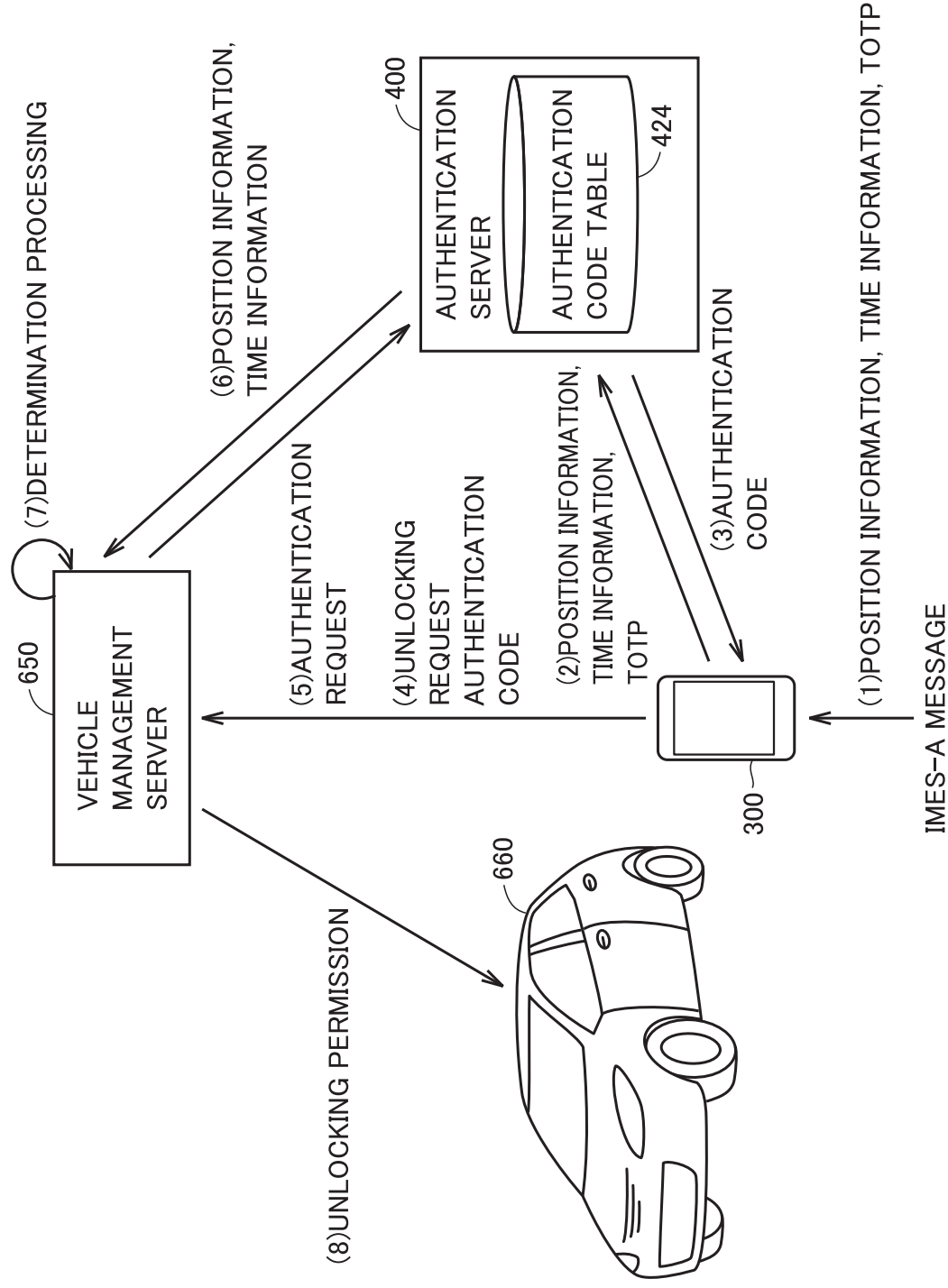


FIG.21

