

Ocean Signal AIS Transponders Time Division Multiple Access. What does this mean and how does it work?

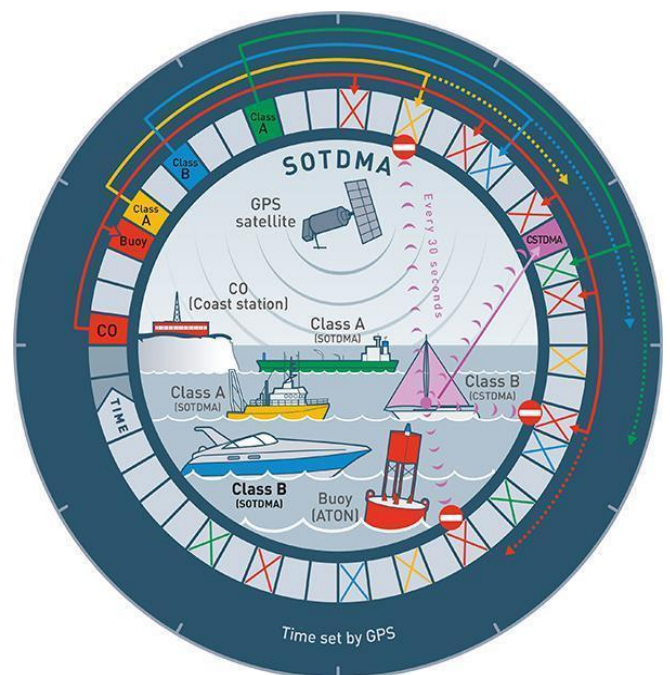
CSTDMA, SOTDMA, Class A, Class B+, slot collisions, slot re-use. These are some of the words and acronyms used in the world of AIS. I will try to explain the most common used for AIS. Hopefully at some point you will see similarities and will be able to better understand not only AIS but also commonly used phrases for systems such as 4G and 5G cellular telephone networks.

Time Division Multiple Access (TDMA) is a channel access method for shared medium networks. It allows multiple users (AIS transponders) to share the same frequency channel (Channel A 161.975MHz (VHF:87 high) and Channel B 162.025MHz (VHF: 88 High) by dividing the signal into different time slots. The AIS transponders transmit in rapid succession depending on message and type of AIS, one after the other, each using its own time slot. This allows multiple stations to share the same transmission medium (e.g. radio frequency channel) while using only a part of its channel capacity.

Class A and **Class B+** use a **TDMA** system called **SOTDMA**, Self-Organized Time Division Multiple Access. This is the most complicated system of all but it makes it possible to autonomously arrange a distribution of available time slots between all AIS transponders within range (cell coverage) and even communicating via other cells when a slot collision may occur in the near future. Without any intervention of humans, the system can appoint time slots between operating units based on priority.

The key elements for operating SOTDMA:

- All stations share a common time reference (derived from GNSS time) ensuring they can all accurately determine the start time of each TDMA slot. **Consequently, the reason for an internal GNSS receiver.**
- **Each data transmission includes an indication of the TDMA slot that will be used by the transmitting station for subsequent transmissions.** This allows receiving stations to build up a 'map' of which slots are in use by which station.
- Each station avoids using slots known to be in use by other stations for its own transmissions. **This prevents two stations in range of one another using the same slot.**
- As mobile stations move from one area to another, they encounter new stations with different slot allocations. **This may cause the station to modify its own slot allocation leading to a dynamic and self organising system over time and space.**



Older and low-cost Class B transponders use a TDMA system called **CSTDMA, Carrier Sense Time Division Multiple Access**. This system is developed to work in full compliance with the SOTDMA system, however to ensure SOTDMA transmissions, CSTDMA is always lower priority. A CSTDMA system continuously monitors the AIS radio channels background noise level in order to detect and confirm if a timeslot is available. A transmission will be made every 30 seconds if a timeslot is available. The timeslot is randomly chosen and will be confirmed to “listen” to the timeslot if it is available. This also explains the reason for less information being broadcast since less space (time) is available within the chosen timeslot. A transmission can be blocked and the transponder will have to wait until a randomly chosen next timeslot to operate in the same way as described above.

Two other systems need to be mentioned in this article for better understanding. In order to have the SOTDMA system fully operational Class A and Class B+ transponder also make use of the following TDMA schemes. RATDMA and ITDMA.

RATDMA,

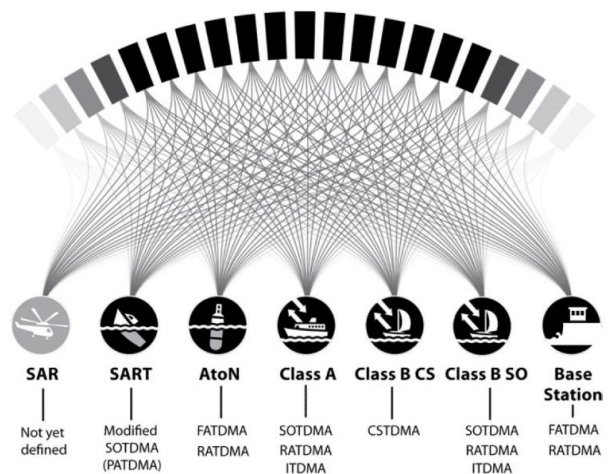
Random Access Time Division Multiple Access.

RATDMA is a simple TDMA access scheme available for certain types of data transmission and AIS device types. RATDMA is used when a station needs to allocate a slot, which has not been pre-announced. This is generally done for the first transmission slot during data link network entry (first transmission after a slot plan has been constructed), or for messages of a non-repeatable character (such as transmission of ASM, Application Specific Messages).

ITDMA,

Incremental Time Division Multiple Access.

ITDMA is used in specific situations to pre-announce the transmission slots for non-periodic messages. These messages can consist of Safety Related Messages or temporary changes in the periodical reporting intervals.



FATDMA,

Fixed Access Time Division Multiple Access

Only used for AtoN’s type 1, only transmission in a pre-programmed timeslot when under supervision and “protection” of a base station.

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