Marine Navigator

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Overview

Marine Navigator is an offline navigator. It uses raster navigational charts (RNC-charts) to plot your position in real time. RNC's are digital images of paper charts (*.kap files). They are offered by various internet sites. This way you can navigate with true copies of official paper charts on your mobile device. After you have made the charts available on the SD-Card of your mobile device the Marine Navigator operates completely offline. This full version of the Marine Navigator provides besides the basic navigation functions of the lite version:

- real time positioning (instantly shows a vessel's position and course on the chart)
- display of navigational data (position, speed over ground, course over ground)
- distance and bearing calculation
- GPS status

the following enhanced navigational functions:

- automatic switching of charts depending on current location and zoom level
- chart rotation (True North, True Course, Compass Heading, Chart Up)
- tracks including recording
- waypoints
- intuitive route editor
- follow route
- gpx import/export of waypoints, routes and tracks
- compass (magnetic north, true north)
- different dashboard layouts (basic data, detailed route data, detailed GPS data)
- support of non-Mercator projections (Polyconic, Transverse Mercator ...) by using polynomials
- automatic correction of geodetic datum (e.g. European50, ...) if northing and easting is specified in header (parameter DTM)
- Support of AIS receiver connected via WIFI (UDP or TCP)[*]
- Display of AIS data including collision detection[*]

[*]in app billing feature

Limitations

Marine Navigator ignores the correction and update entries (ARE) of RNC-charts. Just the raster data are processed. Contact the provider of the chart for late corrections.

Marine Navigator directly supports Mercator projection. Other projections (e.g. Polyconic, Transverse Mercator, ...) are approximated by means of polynomials. If the chart comes with polynomials (PWX, PWY, WPX, WPY) these polynomials are used for the approximation. If the chart doesn't include polynomials the app calculates them by using the reference points. In this case an insufficient number of reference points (less than 10) can result in significant errors.

Basics
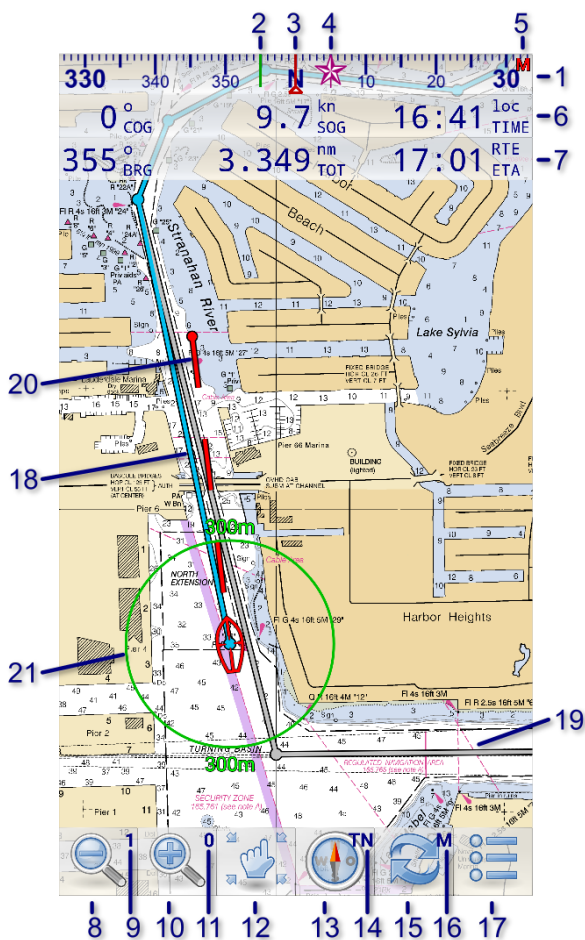
1. compass

2. true heading (green line)

3. magnetic heading (red line)

4. true north (icon)

5. bearing indicator (T=true, M=magnetic)

6. ship data (basic)
   - course over ground
   - speed over ground

- ◦ local time

7. route data (basic)

    - ◦ bearing to next route point

    - ◦ total distance of remaining route

    - ◦ estimated time of arrival

8. zoom out (long click: next smaller-scale chart)

9. number of available smaller-scale charts

10. zoom in (long click: next larger-scale chart)

11. number of available larger-scale charts

12. change scroll mode (long click: center chart)

13. change chart rotation mode

14. rotation mode indicator (TN: True North; TC: True Course; CH: Compass Heading; CU: Chart Up)

15. change chart (long click: change chart switching mode)

16. chart switching mode indicator (A: Automatic; M: Manual)

17. menu (Import, Help, Logging, Routes, Waypoints, ...)

18. remaining route segments

19. passed route segments

20. true course line including expected position after defined time span

21. distance circle

Dash Boards

Marine Navigator provides three dash board layouts:

- Main Dash Board

358° COG	9.7 kn SOG	17:57 loc TIME
21° BRG	0.662 nm DIS	18:03 WPT ETA
350° BRG	2.009 nm TOT	18:10 RTE ETA

    The main dash board shows the basic data for the ship (course over ground, speed over ground, local time), for the marked target (bearing, distance, estimated time of arrival) and for the route (bearing to next route point, total distance to final destination, estimated time of arrival).

- Route Dash Board

```
No. BRG   DIST  TOTAL     ETA
  1 350 0.776 0.776 18:02
  2  17 0.111 0.887 18:03
```

The route dash board shows a scrollable list of route points of the current route. Each row shows the basic data of one route point (bearing from previous route point, distance from previous route point, total distance to final destination, estimated time of arrival).

- GPS Dash Board

```
26°05.719'N  80°07.083'W
COG:358° SOG:9.7kn 18:00
26°06.150'N  80°06.750'W      WPT
BRG:  21° DIS:0.662nm    ETA:18:03
26°05.719'N  80°07.083'W      RTE
BRG:350° TOT:2.009nm     ETA:18:10
```

The gps dash board shows detailed GPS data for the ship, the marked target and the route. Additionally, a bar chart shows detailed information about the status of the satellites. A colored bar shows the SNR of an used satellite (The color changes from RED(0) over YELLOW(30) to GREEN(60)). A gray bar stands for a satellite which is in view, but not used).

To change between the dash boards, just slide your finger over the dash board from left to right or right to left.

Bearings and courses are shown relative to true north or magnetic north indicated by the bearing indicator in the top right corner of screen. Click the compass in order to switch between magnetic and true bearings and courses.

Import of BSB/KAP Charts

Marine Navigator doesn't come with pre-installed nautical charts. Instead it is able to import BSB/KAP raster navigational charts. RNC's are available for free at various internet sites:

- https://www.nauticalcharts.noaa.gov/charts/noaa-raster-charts.html
  (Suite of NOAA nautical charts that covers the coastal waters of the U.S. and its territories)

- https://www.marinha.mil.br/chm/chm/dados-do-segnav/cartas-raster
  (Suite of BSB nautical charts that covers the coastal waters of Brazil and its major rivers)

- https://www.linz.govt.nz/sea/charts/nzmariner-official-raster-navigational-charts-rncs
  (NZMariner is the product name of New Zealand's Official RNC folio.)

- http://www.openseamap.org
  (Openseamap charts are based on Openstreetmap data enriched with additional nautical information. The charts cover selected european coastal waters).

Press one of the download buttons at the bottom of the import list screen to open the corresponding download site in your default internet browser. To open the import list screen select

`Menu|Import`(Press the MENU button and then select option Import).
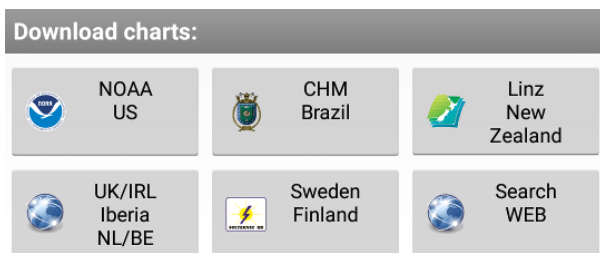
If your browser downloads the charts into Android's default download folder the downloaded charts will automatically be listed in the import list after download completes. In this case skip step 1 and 2 of below procedure.

Follow the following simple steps in order to make single raster charts (*.kap files) or archives with multiple charts (*.zip files) available for navigation:

1. Store the original RNC charts (*.kap file) or archives with multiple charts (*.zip files) in `BSB_ROOT` or any subdirectory below `BSB_ROOT`. Per default `BSB_ROOT` is set to /sdcard/bsb_root. You can change the location of `BSB_ROOT` to any directory of your choice by clicking the title bar of the chart import list (see next step).

2. Select `Menu|Import` (Press menu button and then select option Import). All available RNC-charts and archives in or below `BSB_ROOT` will be listed. Depending on the size of the subtree below `BSB_ROOT` this may take some time. If you don't see a chart or archive in the list, click the title bar to open a dialog which allows you to change `BSB_ROOT`. Navigate to the folder where you have stored the original charts (*.kap or *.zip files). Click long on the folder to set this folder as new `BSB_ROOT`.

3. Choose a chart or archive from the list to start the import process. The icons have the following meaning:

	Archive with multiple charts.
	Chart is already imported.
	Chart is not yet imported.

During the import of an archive the following progress indicator is shown:

The indicator shows the current chart in progress and the total number of charts to be imported. Charts which have already been imported and are up-to-date are not counted.

Press `Cancel` to cancel the import of the archive.

Press `Skip One` to skip the current chart and continue with the next one.

During the import of a single chart the following progress indicator is shown:

Press `Cancel` to cancel the import of the chart.

After the import of a single chart is finished the new chart will be added to the list of imported charts and displayed in the navigation view.

All chart are imported into chartsets. Single charts (*.kap) are imported into the chartset DEFAULT. The import of an archive (*.zip) of KAP charts (*.kap) results in a new chartset with the name of the archive (without extension). Archives (*.zip) of MNX charts are stored in chartsets defined by the internal folder structure of the archive.

Enhanced Import Procedures

In order to process the import in the background just press the `Back Key` when the import dialog is shown. To bring the import job in the foreground again select `Menu|Import`.

To resume a cancelled import just start the import of the archive again. The application will detect the already imported charts and will continue the import with the first not yet imported chart.

In order to update the charts of an archive just download the updated archive and start the import again. The application will detect updated charts by comparing the source edition, raster edition and ntm edition.

If you just want to reload the header data of an already imported chart (e.g. if a new version of the app reads more data) you can set the preference `BSB_header_update` to `forced` (`Menu|Settings`). In this

case the app will reload the header data even if old and new chart are identical.

Charts are imported into app internal directories and managed by the app. You don't need to take care of the storage location of the chart. If the app will be uninstalled the charts will be cleaned up automatically. Further the app will choose the best suitable storage device to store the charts depending on available space. All available storage devices are taken into account (internal device storage as well as external SDCARD if present).

The new storage access restrictions introduced with Android version KITKAT doesn't allow the app to write to the external SDCARD. Therefore external folders defined and managed by the user are not supported anymore. Chartsets imported with Marine Navigator version <= 2.1.7 into external folders can be migrated into the app internal folders. Open the chart list and select option `Menu|Migrate`. Navigate to the external folder and press button `Migrate all`. All chartsets stored in the external folder will be migrated into the app internal folders.

Import of 3rd party MNX Charts

Native Marine Navigator MNX-charts are offered by selected 3rd party chart distributors:

- http://www.visitmyharbour.com
  (Chart sets for UK/IRL and IBERIA derived from official UHKO charts. These charts are not free. Further regions are coming)

- http://maps.soltek.se
  (Chart sets for Sweden and Finland)

MNX chartsets are distributed in form of zip archives (*.zip). Just download the zip archive either into the default download folder or into `BSB_ROOT`. Afterward open Marine Navigator. Select option `Menu|Import` and import the downloaded archive. After the import is finished open the import list screen and click the title bar to select the new chartset (details see chapter selecting of chartsets and charts).

If you need further assistance to install a 3rd party archive please follow the detailled instructions given by the chart distributor .

MNX charts can be encrypted. The following icons show the status of encrypted charts:

	Chart is encrypted. Needs to be activated.
	Information to activate chart are missing

In order to activate encrypted charts please press the Activation Button at the bottom of the chart list screen and follow the instruction you have received from the distributor of the chart set.

1138-0.mnx
1138-0.bmp
1:38000 (2373x3151)

Activate Chart Set

The activation button is only visible if the chartset is encrypted and not yet activated. If the information to activate the chart is missing please contact the distributor of the chartset.

Selecting of Chartsets and Charts

Manually selecting a particular chart

Click the following icon in the navigation view to select a particular chart:


A list of all charts contained in the active chartset will be displayed. The icons have the following meaning:

	Active Chart in display.
	Chart covers the current location.
	Chart does not cover the current location.

The charts are sorted with respect to the distance of their mid point to the current position. Choose the chart you want to use by tapping the corresponding list entry. You can filter the charts by means of the radio buttons on the top of the screen:

- **All Charts:** List all charts
- **Short List:** List only charts which cover the current location

Charts are organized in chartsets. Single charts are stored in the chartset DEFAULT. In order to view a particular chart which is not contained in the active chartset you have to select the corresponding chartset first. If you open the chart list the first time the charts in the chartset DEFAULT are shown. In order to select another chartset click on the title bar.
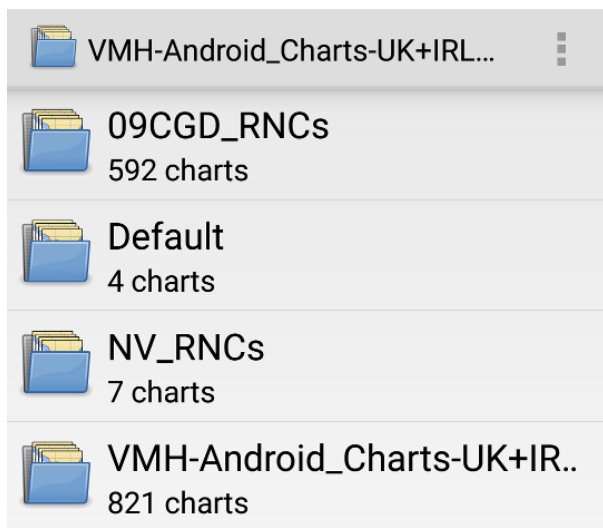
Manually selecting a chart which covers the current location

In order to circle through all charts available for the current location click long on the zoom buttons. The number in the zoom button indicates the available charts for zoom in and zoom out respectively.

Automatic chart switching

A long click on icon:

toggles the chart switching mode between automatic and manual.

- **Automatic Chart Switching Mode:** In this mode the app automatically selects the best fitting chart for the given location and zoom level. Whenever the chart is scrolled or the zoom level is changed the app determines the chart which covers the current mid-screen location and comes closest to the currently selected scale.

- **Manual Chart Switching Mode:** The app will not change the chart even if the current location is not covered by the active chart. Use this mode if you want to use a particular chart even if the scale is not optimal.

If you manually select a particular chart from the active chartset the chart switching mode is reset to Manual.
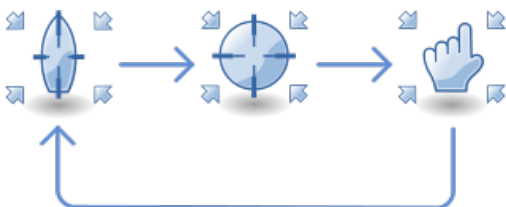
Change Scroll Mode

Clicking on the scroll mode icon changes the scroll mode. The icon indicates the current mode:

	Follow current GPS position.

	Stay with marker.
	Manual scrolling.

With each click on the icon the application switches through the scroll modes in the following order:

If the marker is cleared the mode `Stay with marker` is skipped.

Change Chart Rotation Mode

Clicking on the chart rotation icon changes the rotation mode. The letter in the upper right corner indicate the current mode:

TN	True North: The chart is oriented to True North. Skewed charts are rotated.
TC	True Course: The chart is continuously rotated into the direction of the true course of the ship based on the GPS data.
CH	Compass Heading: The chart is continuously rotated into the direction indicated by the compass. The charts follows the rotation of the device.
CU	Chart Up: The chart is not rotated at all. It remains in the original orientation.

The compass needle of the icon always shows to true north.
With each click on the icon the app switches through the rotation modes in the following order:
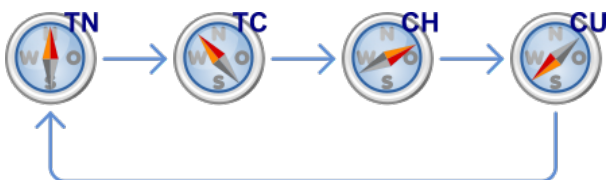
Tracks

Record a Track

Select `Menu|Logging|Start Logging` to start recording of tracks. Recorded tracks are displayed by a

green line. The number of recorded track points depends on the logging mode and is only limited by the size of your device internal storage.

Power Saving Mode

If the app runs in the foreground the location is updated about ones per second and recorded. If the app runs in the background the frequency of location updates is reduced to one update every 120 seconds in order to preserve power.

Maximal cross track error and turn

The location is updated about ones per second but is only recorded if the updated location deviates from the track more than the defined maximal cross track error or the bearing deviates more than the defined maximal turn.

Maximal distance and time

The location is updated about ones per second but only recorded if either the maximal distance or the maximal time related to the last recorded track point is exceeded.

Save a Track

Select `Menu|Logging|Save As` to store tracks in GPX-format. This can take some time depending on the number of recorded track points. The track is stored in the folder bsb_root/tracks on your primary external storage (usually your device storage). Clear the track after saving to avoid very long tracks which are hard to handle.

Display a Tracks

Per default the app displays the last 1000 track points. You can select another section of the track by moving the slider on the right side of the screen. You can change the length of the section by using the two-finger-pinch gesture on the slider.

Waypoints

Click long on the chart to set a waypoint. Select option `Set Waypoint` in the context menu. Enter the waypoint data into the following form:

In order to edit an existing waypoint long click the waypoint on the chart and select option `Edit Waypoint`

Select `Menu|Waypoints` to manage waypoints (Save, Open, Add, List, Delete, Edit waypoints). In order to import waypoint copy the file which contains waypoints in GPX-format into the folder bsb_root/waypoints on your primary external storage (usually your device storage) and select `Menu|Waypoints|Open Waypoints` to open the file. Waypoints can be exported by selecting option `Menu|Waypoints|Save All Waypoints`. The way points are stored in folder bsb_root/waypoints.

Marker

You can set a marker to mark a target. The Marine Navigator will automatically calculate the bearing and the distance to the marker. Two different methods of calculation can be set (see Settings)

- LOXODROME (rhumbline)

- ORTHODROME (great circle)

In order to set the marker just tap long the location on the chart. As long as the marker is red colored it can be moved around by sliding the finger over the display. The location of the marker will be fixed automatically (color will switch to green) 2 second after you stop to move the marker around.

Alternatively, you can scroll the chart to the position you would like to mark and then tap the cross hairs to set the marker.

To clear the marker click long on the chart and select option clear marker in the context menu.

Quick Info

If scrolling the chart the scroll position is indicated by cross hairs. The quick info is shown close to the cross hairs. In the settings the following data can be selected to be shown:

- none

- GPS position data and distance from marker to scroll position (green) and from ship to scroll position (red)

- GPS position data and bearing from marker to scroll position (green) and from ship to scroll position (red)

- distance and bearing from marker to scroll position (green) and from ship to scroll position (red)
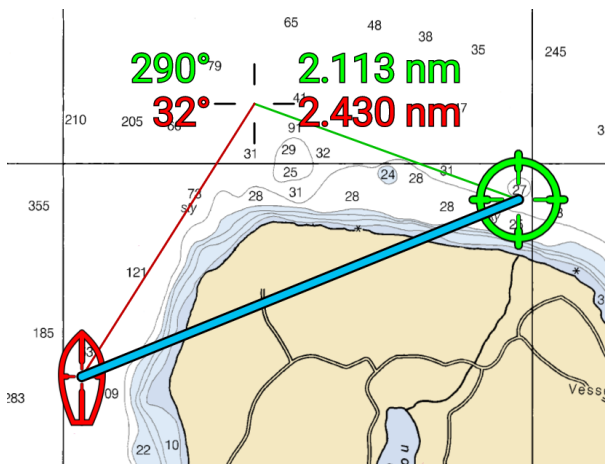
Man Over Board

If a man goes over board tap long the screen and select option Man Over Board. The Navigator will set a way point when it receives the next location update. The way point is marked with MOB followed by the time when the way point was recorded. If the time elapsed between pressing Man Over Board and recording of the way point is greater than 30s the delay in minutes will be appended to the label, e.g. MOB Sep 10, 23:45-2. MOB way points will be saved automatically. You have to delete them explicitly. You can record more than one MOB. Only the last recorded MOB is marked.

Routes

Open and Save Routes

The app is able to open and saves routes in GPX-format. You can exchange routes with any application which supports the import and export of routes in GPX format. Select Menu|Routes to

store or save routes. Routes are stored in the folder bsb_root/routes on your primary external storage.

Display Routes

The route dash board shows a scrollable list of all route points. You can jump to a certain route point by clicking a row in the route point list or you can jump to a certain row by clicking a route point in the chart.

Edit Routes

The app features an intuitive route editor. Select `Menu|Routes|New` to create a new route or `Menu|Routes|Edit` to edit an already loaded route. Afterwards long click anywhere on the screen to set a new route point. Alternatively, you can scroll the chart to the position where you would like to set a new route point and then tap the cross hairs to set the route point. You can append, prepend, move, insert and delete route points by clicking long on the screen. The position of existing route points can be changed easily. Just click the route point and slide your finger anywhere on the screen until the route point is positioned correctly. Select `Menu|Routes|Exit Editor` to close the editing mode.

Follow Routes

The app can automatically follow an open route. Select `Menu|Routes|Follow` and the app will show the bearing and distance to the next route point. After you have reached a route point the app will automatically switch to the next route point. Use the route dashboard to get detailed information about the open route. The main dashboard will show the most important data (bearing to next route point, total distance to final destination and estimated time of arrival). If you are following a route, but the direction is wrong, select `Menu|Route|Reverse`.

Compass

Marine Navigator features a Compass which uses the magnetic sensor, the acceleration sensor and optionally the gyroscope to determine the magnetic heading.
It also uses Androids inbuilt World Magnetic Model produced by the United States National Geospatial-Intelligence Agency to calculate magnetic declination (variation). Currently WMM-2010 is used which is valid until 2015, but should produce acceptable results for several years after that. Future versions of Android may use a newer version of the model. The compass shows magnetic heading (red line). If the position is known the compass also shows the true heading (green line). The device can be aligned to true or magnetic heading by tapping on the compass. The little triangle at the bottom indicates the active alignment (true or magnetic). The true north icon shows the direction to true north.
In the below picture the magnetic variation is 5°W.

Magnetic heading is 360°. True heading is 355°. The device is aligned to magnetic heading. True north is at 5°(magnetic) indicated by the true north icon.

The compass should be used with care. The accuracy of the compass depends on the accuracy of the sensors. Sensors needs to be calibrated.

There are two different modes to read the sensors (see `Menu|Settings`):

- The Fusion Sensor mode uses the gyroscope to get a steady heading. The readings from the magnetic sensor and the accelaration sensor are very noise. Therefore the reading are correlated with the output of the gyroscope to get a steady heading.

- The MAG-ACC mode uses the magnetic sensor and the accelaration sensor to determine the magnetic heading. The output of this mode is very noisy.

The output of both modes is smoothen by a low pass filter which can be adjusted in the settings. The default mode is MAG-ACC with a high smoothing factor.

If your device doesn't feature a Gyroscope or the Fusion Sensor implementation doesn't work correctly you should use the MAG-ACC mode.

AIS - automatic identification system (optional add-on)

AIS (automatic identification system) is an automatic tracking system used for collision avoidance on ships. AIS requires that the ship is equipped with a dedicated VHF AIS transceiver that allows to receive AIS reports from nearby vessels while transmitting information about the ship itself to other AIS transceivers. Marine Navigator can be connected to an on-board AIS receiver via WiFi by listening on a configurable local UDP port or by connecting to a specific remote TCP port served by the AIS receiver.

The following AIS reports are supported:

- Type 01: Position Report Class A
- Type 02: Position Report Class A (Assigned schedule)
- Type 03: Position Report Class A (Response to interrogation)
- Type 05: Static and Voyage Related Data
- Type 18: Position Report Class B Standard
- Type 19: Position Report Class B Extended
- Type 24: Static Data Report Class B

The AIS feature requires an AIS-receiver. Any AIS receiver able to send the received AIS NMEA reports via WiFi (UDP client or TCP server) should be supported (see below for instructions to set up the connection between Marine Navigator and the AIS-transceiver)

Set up

Please open `Menu|Settings` and scroll to section AIS to configure the connection to the AIS receiver. Select the protocol (UDP or TCP) supported by your AIS receiver and set the protocol specific configuration parameters (UDP port or TCP server address and TCP port respectively). Further, make sure that your Android device has switched-on WiFi and is connected to the wireless network (SSID) of your AIS receiver. Read the manual of your AIS receiver for further details.

AIS overlay

The ais overlay shows the position as well as static voyage related data of the ais targets.

In the above figure both vessels have send position reports and static voyage related data (name of vessel, call sign, ...). The black dots show the last received position. The black lines show the predicted courses. The position of the vessel is calculated based on the data of the last received position report (position, COG, SOG). The dimensions of the vessels are taken from the last received static voyage related data report. Capt. Morgan has been selected by a simple click on the AIS target. Therefore its detailed data is shown in the upper left corner of the screen and its track based on the previously received position reports is shown by a green trailing line. Capt. Morgan has not specified its destination. Therefore destination information is missing below the call sign.

Collision Detection

The following figure shows a collision alert.
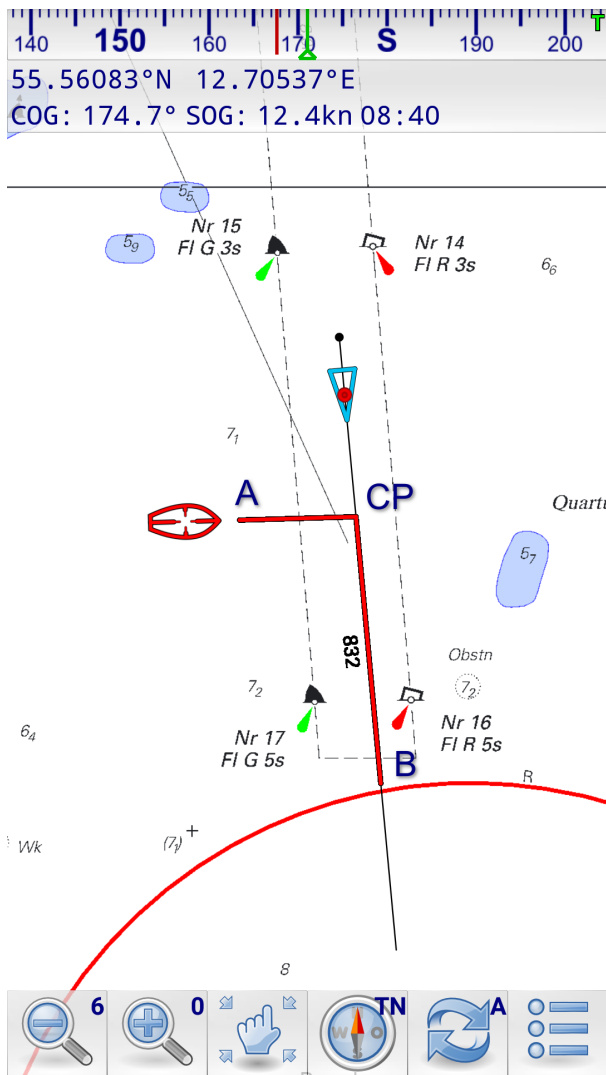
The crossing point of the two course lines is the fictive collision point (CP). The AIS target reaches the collision point (CP) first. At this moment the own ship is at location A. I.e. the red line between location A and the collision point (CP) shows the distance to the AIS target when it crosses the course of the own ship. Afterwards the AIS target continues traveling along its course line to location B. When the own ship meets the collision points the AIS target has reached location B. I.e. the red line between the collision point (CP) and the location B shows the distance to the AIS target when the own ship crosses the course line of the AIS target. In the illustrated case the own ship passes the course of the AIS target 832m behind the AIS target.

The AIS target (red cursor) is selected. It hasn't send any static voyage related data yet. Therefore only data of the position report is shown (position, SOG, COG).

Settings

In order to change settings select `Menu|Settings`. Preferences are initialized to reasonable default values. Each preference comes with a short summary. The available options are self-explanatory.

Credits

Thanks to the Tango Desktop Project for the tango styled icons (http://tango.freedesktop.org/

Tango_Desktop_Project).

Thanks to user Mdf of http://commons.wikimedia.org/ for the nice Mercator projection of the Earth (http://commons.wikimedia.org/wiki/File:Mercator-projection.jpg)

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