



# Project Overview

# Project Structure

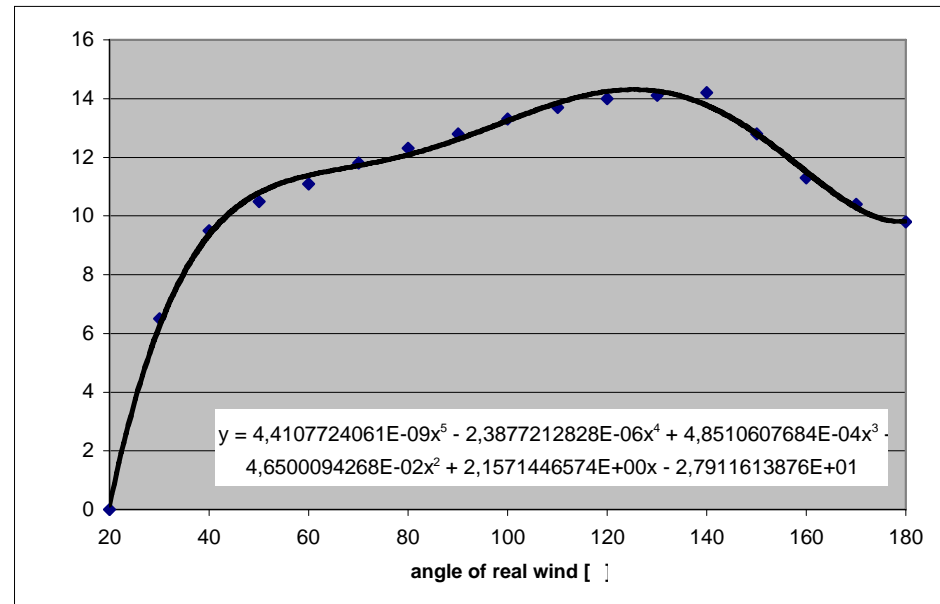
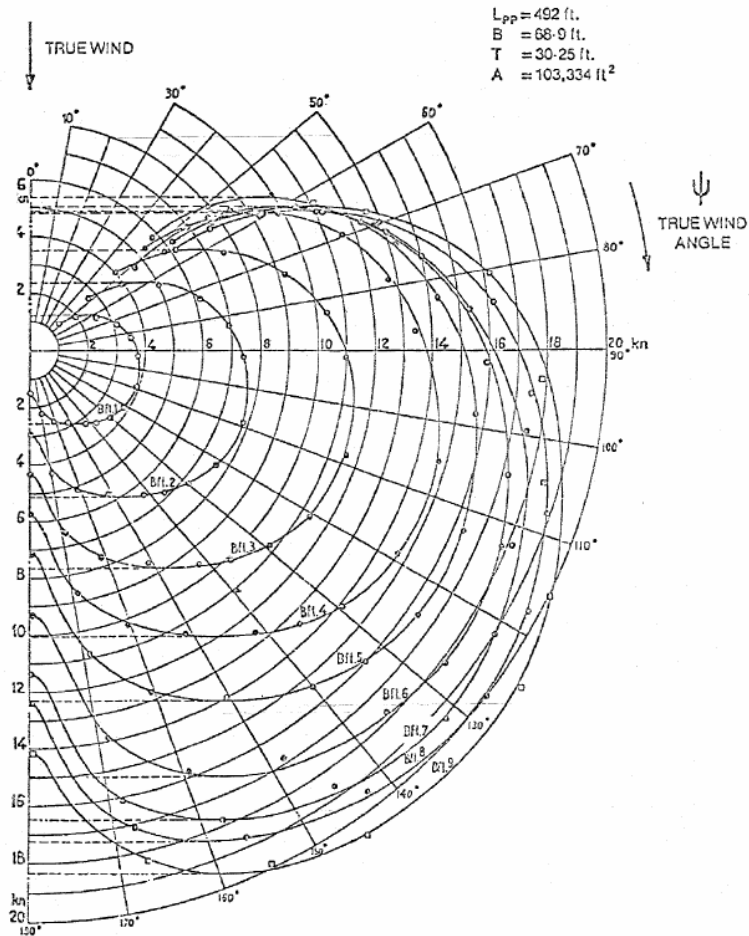
- Sensors & System  
Topology
- Navigation & Control  
Logics
- Simulation &  
Visualisation
- Radio & Power  
Concept
- Boat Construction



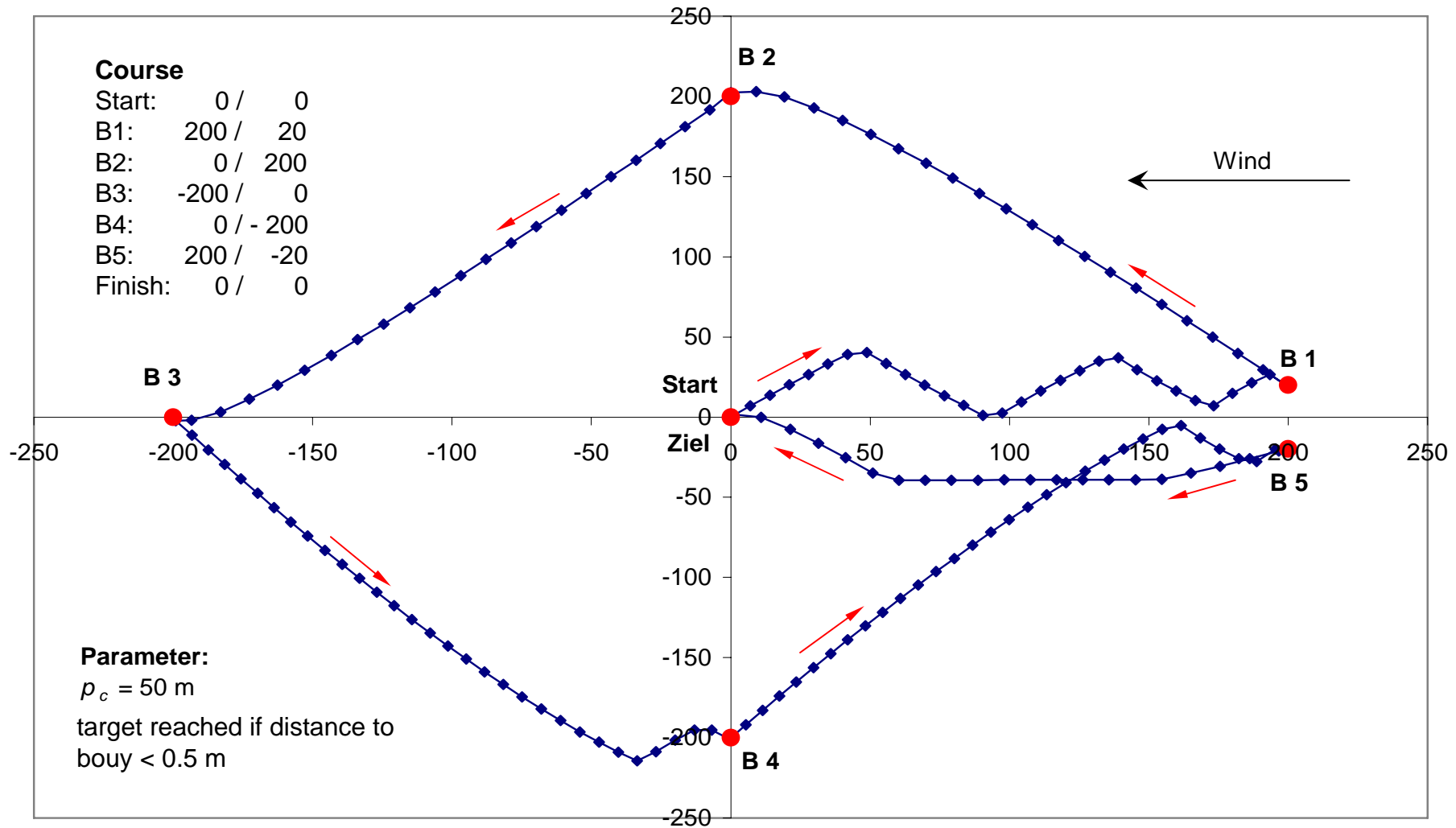


# Weather Routing

# Boat Polar Diagram



# Example Route





# Control Algorithm

# Overview

- Goal
  - sail in the direction given by the Navigator.
- Concrete Accomplishment
  - set rudder
  - set sails

# Two Simple Control Circuits

- Rudder-Control-Circuit
  - Keep boat on the course given by the navigator.
  - Compensation of crabbing
- Sail-Control-Circuit
  - avoid capsizing
  - flow in the sails



# Control System Summary

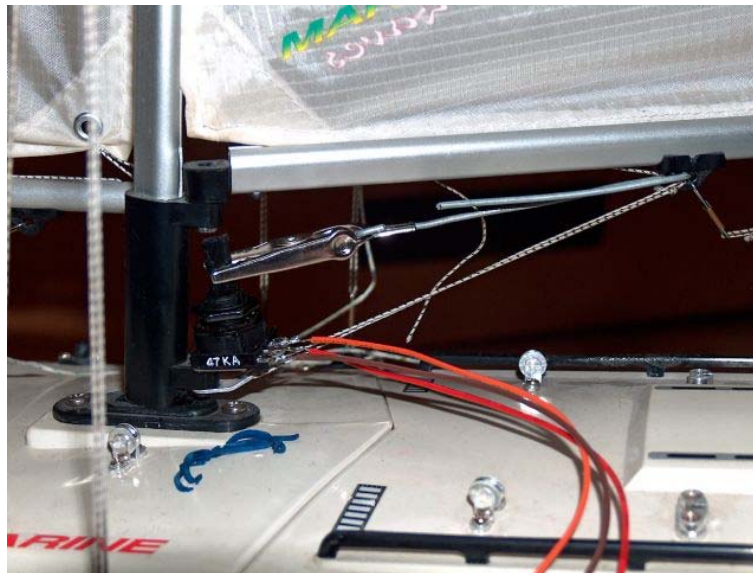
- Implemented with Fuzzy Logic
- Two simple control circuits + a special rule for the jib:
  - sail courses at any wind
  - tack
  - jib
- Only 4 sensors needed:
  - compass
  - heeling
  - boom position
  - apparent wind direction



# Sensorics & System Topology

# Wind Direction

- Potentiometer



# Boom Position

# Wind Speed

- Anemometer
- Reed Contact



# GPS

- Serial Output
- NMEA Protocol



# Direction and Heeling



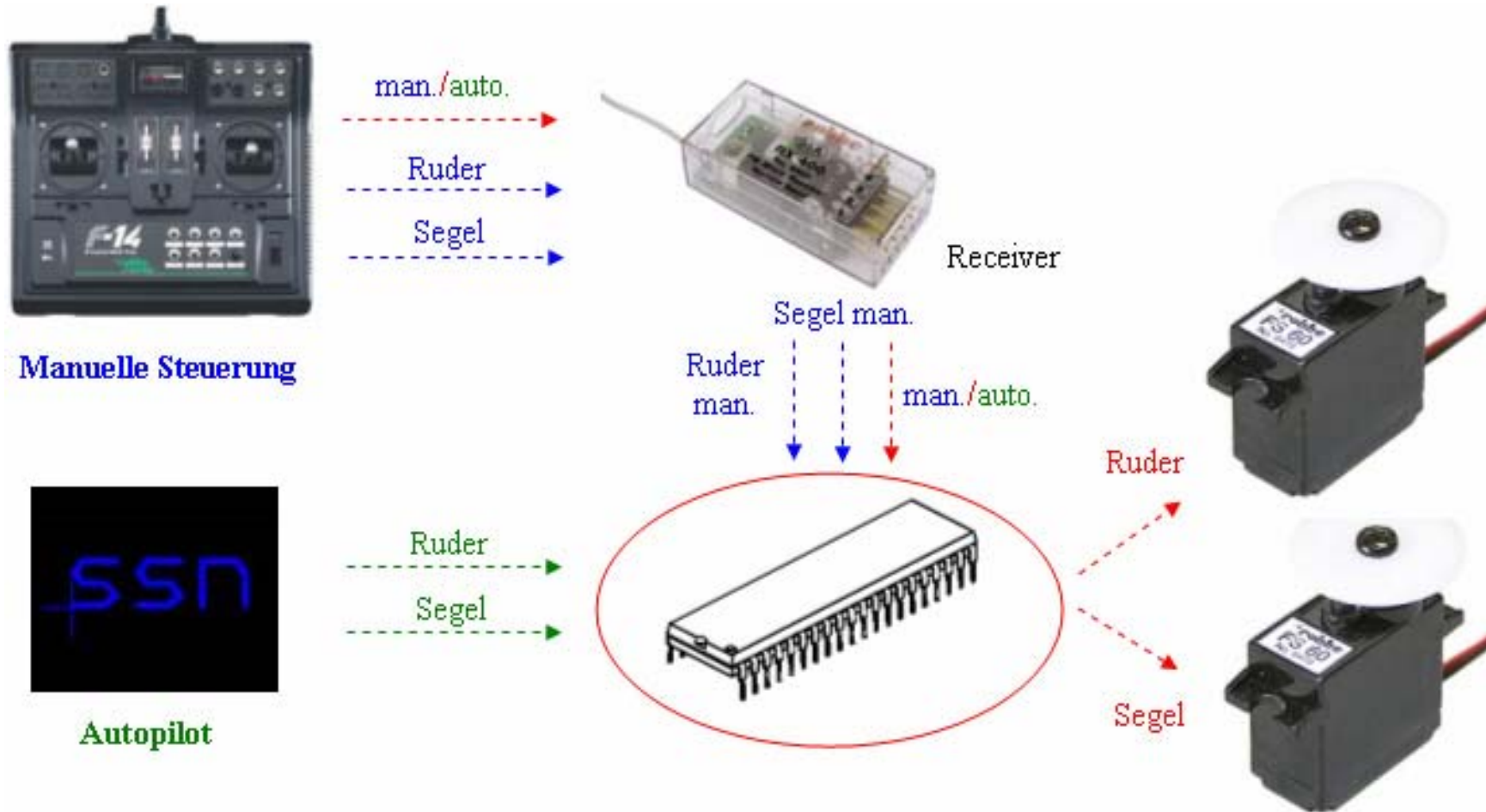
- Tilt Compensated
- Serial Output

# Actuators



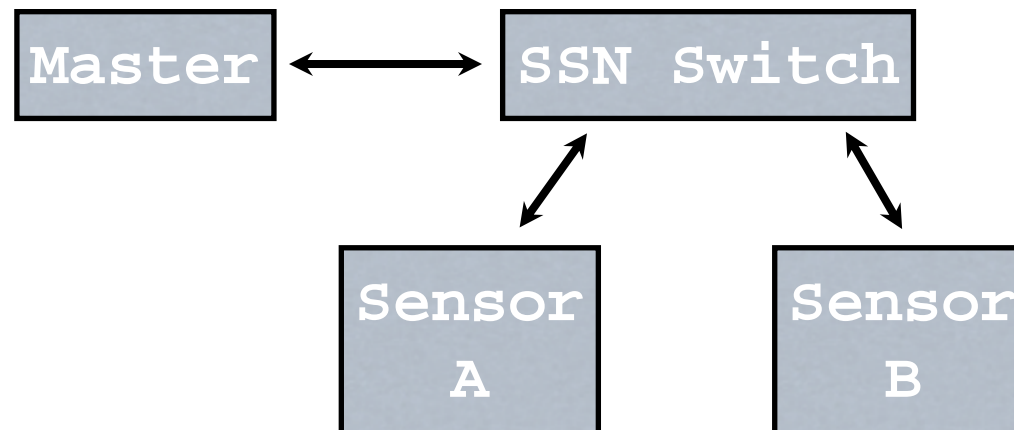
- sail winch
- rudder
- Manual control has to be possible!

# Autopilot / Manual Control

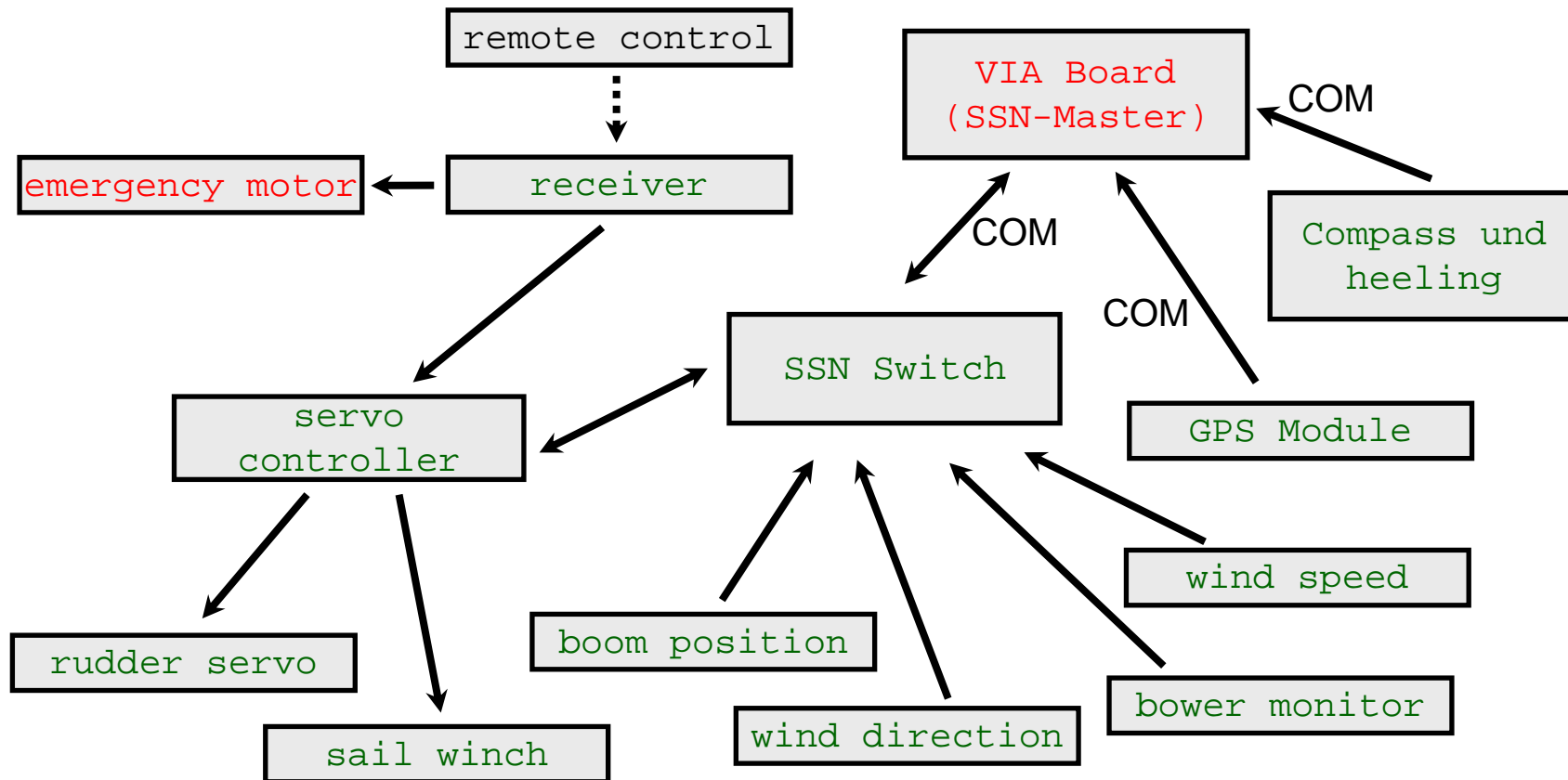


# SSN - Simple Sensor Network

- Communication with Sensors/Actuators
- Based on RS232 Connections
- Easy Addressing



# Overview



## Master

- VIA EP MII-6000E
- 17 x 17 cm
- Passiv cooled
- 2x serial, Compact Flash, Cardbus, USB, ...
- Standard x86 Linux





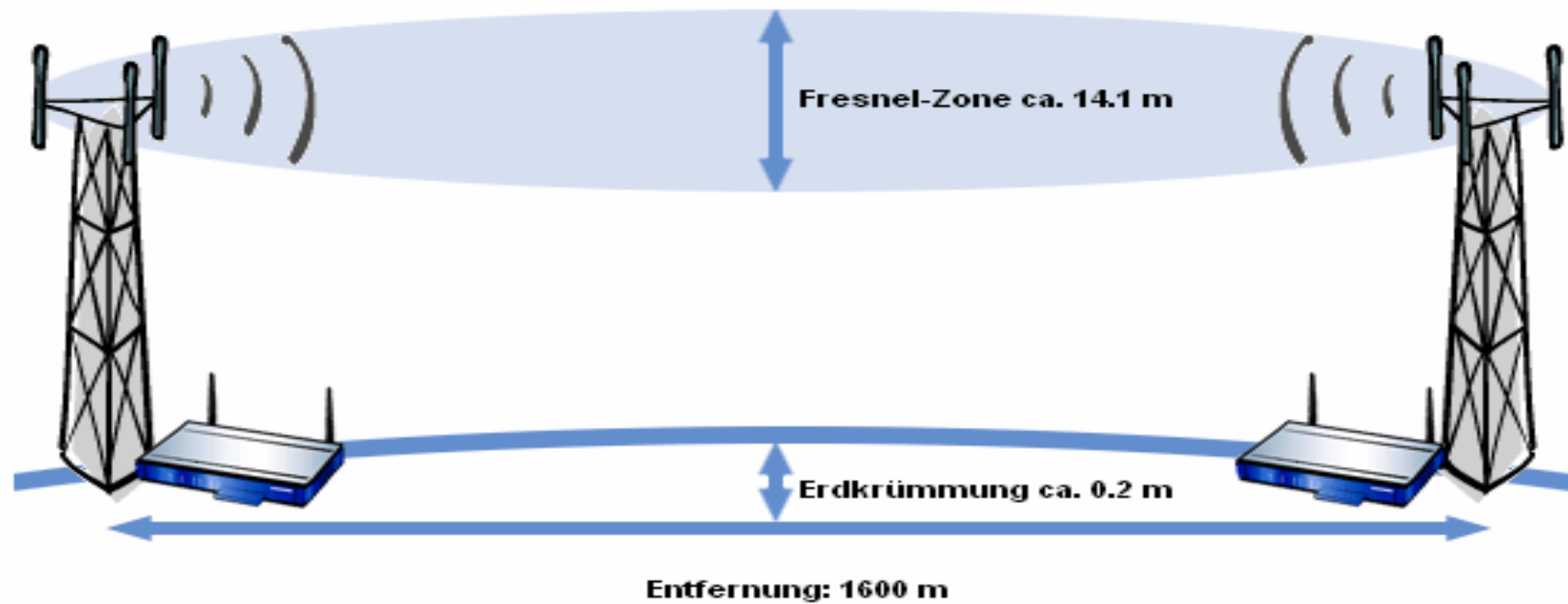
# Wireless Communication

# Datalink

- 1000m ?
- noise-independet
- close to water(!)
- direction independent on the boat
- base station on shore



# Fresnelzone



Die Antenne sollte bei der Frequenz von 2,4 GHz mindestens in einer Höhe von **7.3 m** montiert werden.

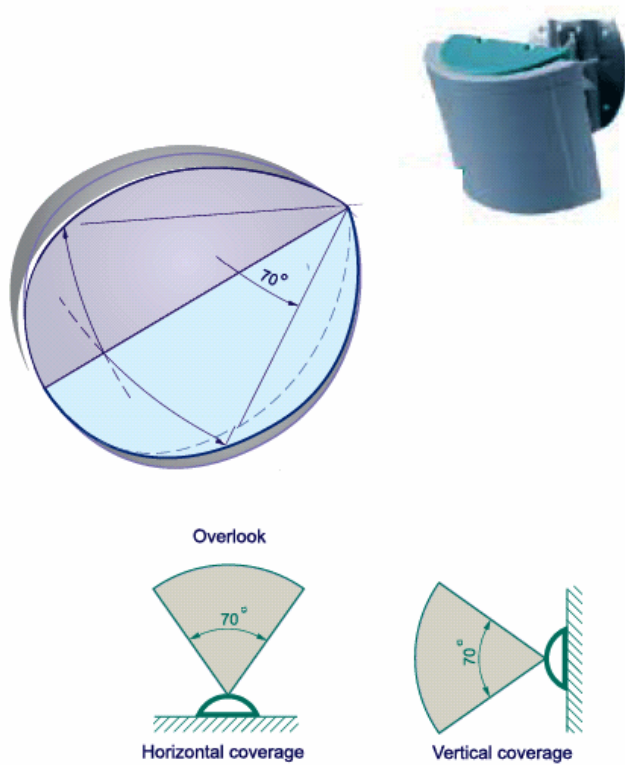
# Tests

- Nordbrücke > Floridsdorferbrücke
- Brigittenauerbrücke > Reichsbrücke
- height above the water is important!



# Antennas

- Sektor antenna
- Yagi



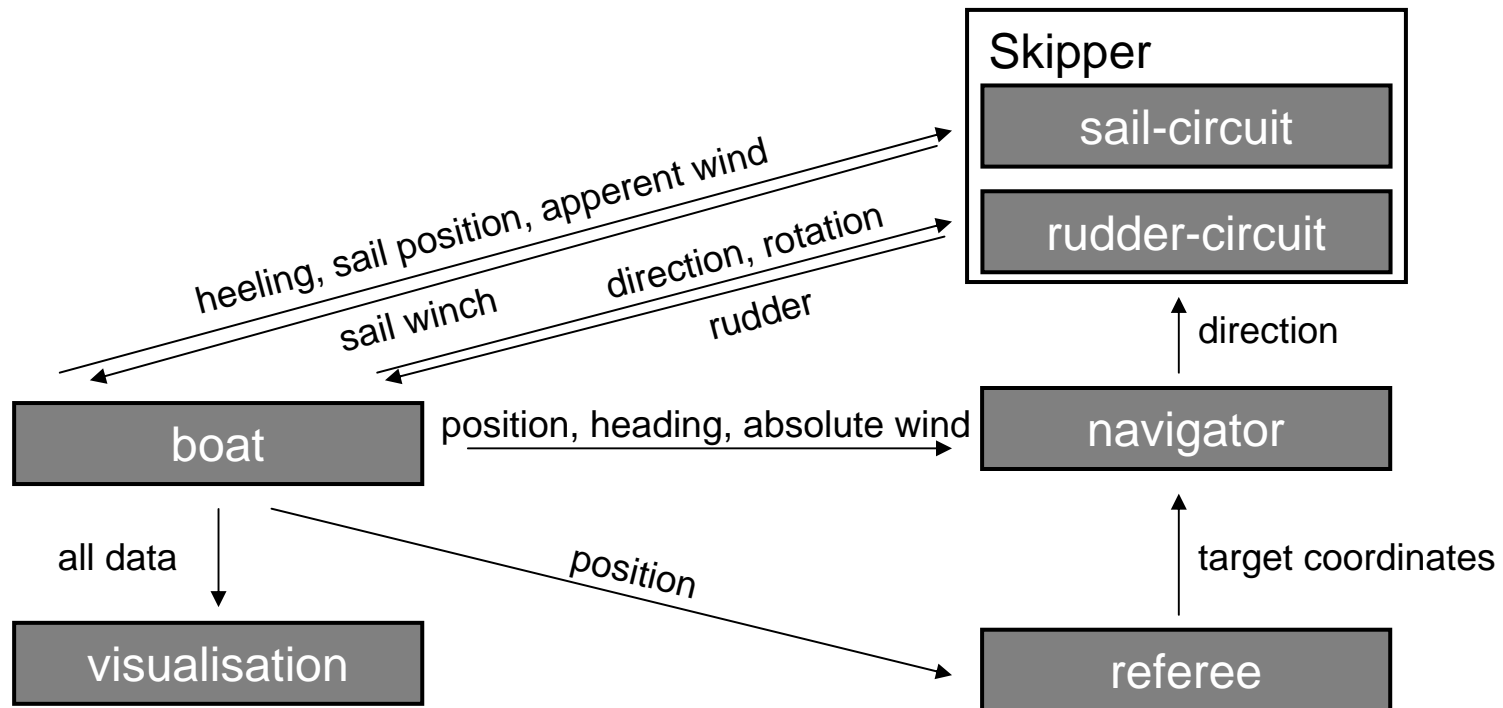


# Software Structure

# Layered Architecture

Navigation Layer	Navigator
Manoeuvre Layer	Skipper
Reflex Layer	
Interpretation Layer	Data Daemon (Boat)
Communication Layer	Simple Sensor Network
Hardware Layer	

# Software Modules



# Implementation

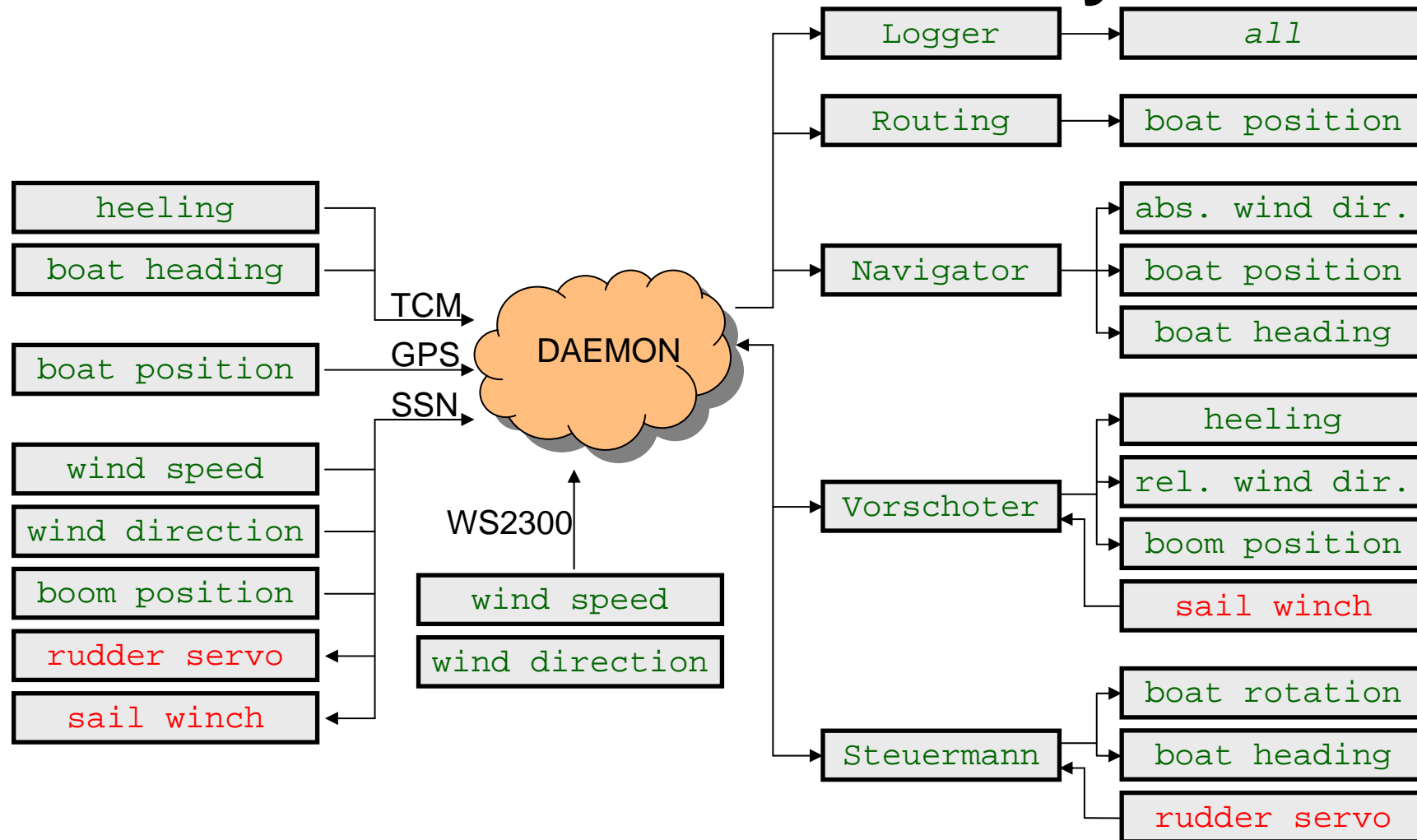
- Boat-Daemon: Java multithreaded TCP-Server
  - data preperation („Interpretation Layer“)
  - communicates over RS232 with SSN-Switch and Sensors
- Navigator
  - implemented in C++
  - communicates over TCP with Boat-Daemon
- Skipper:
  - Base: FuzzyWeb C-Codegenerator
  - communicates over TCP with Boat-Daemon
- Visualisation and Logging
  - implemented in C++
  - is detached from the rest (on shore)
  - communicates over TCP with Boat-Daemon

# SSN Daemon

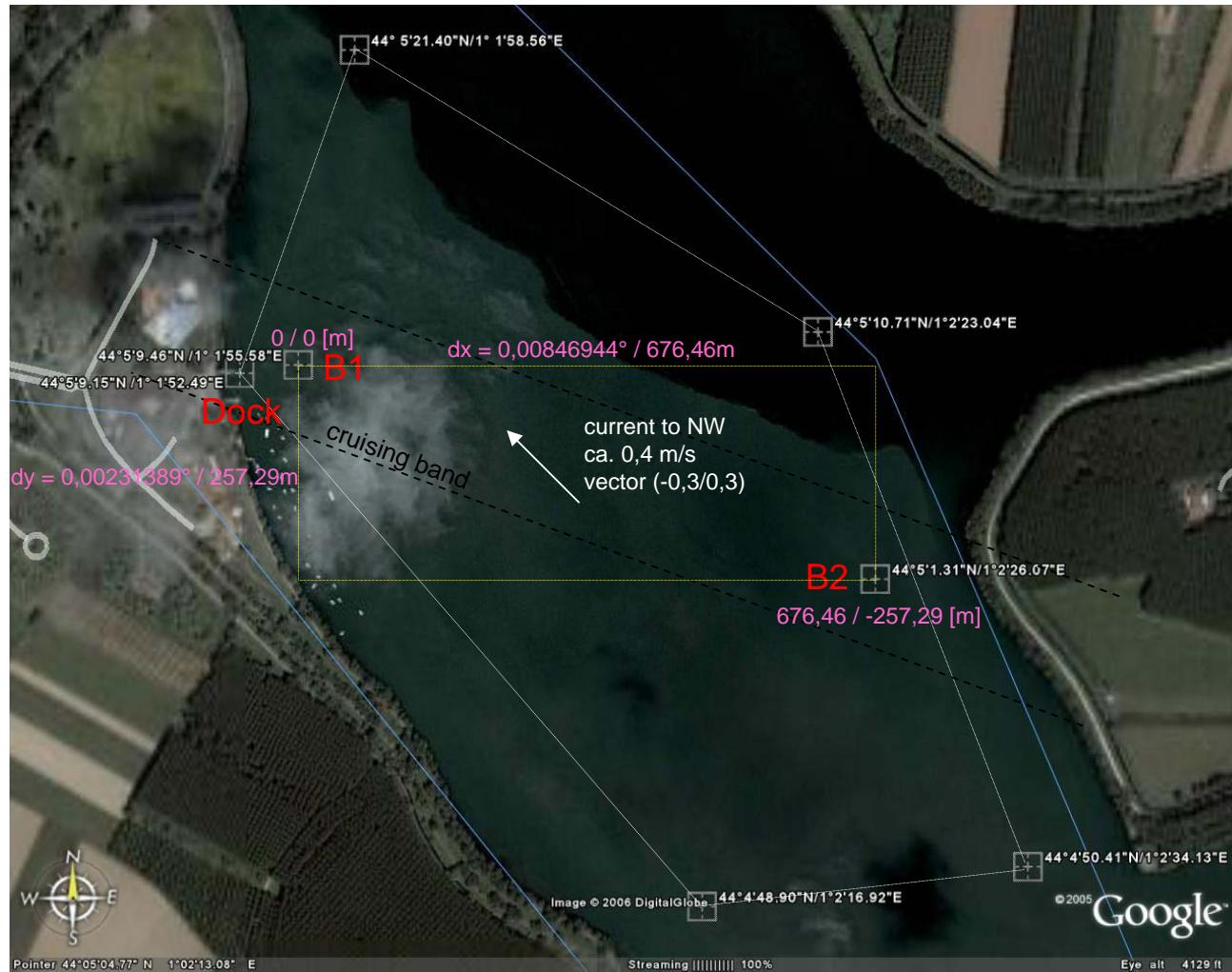
- reads sensor values continuously
- offers values to other parts of the program
- conversion / abstraction
- data logging



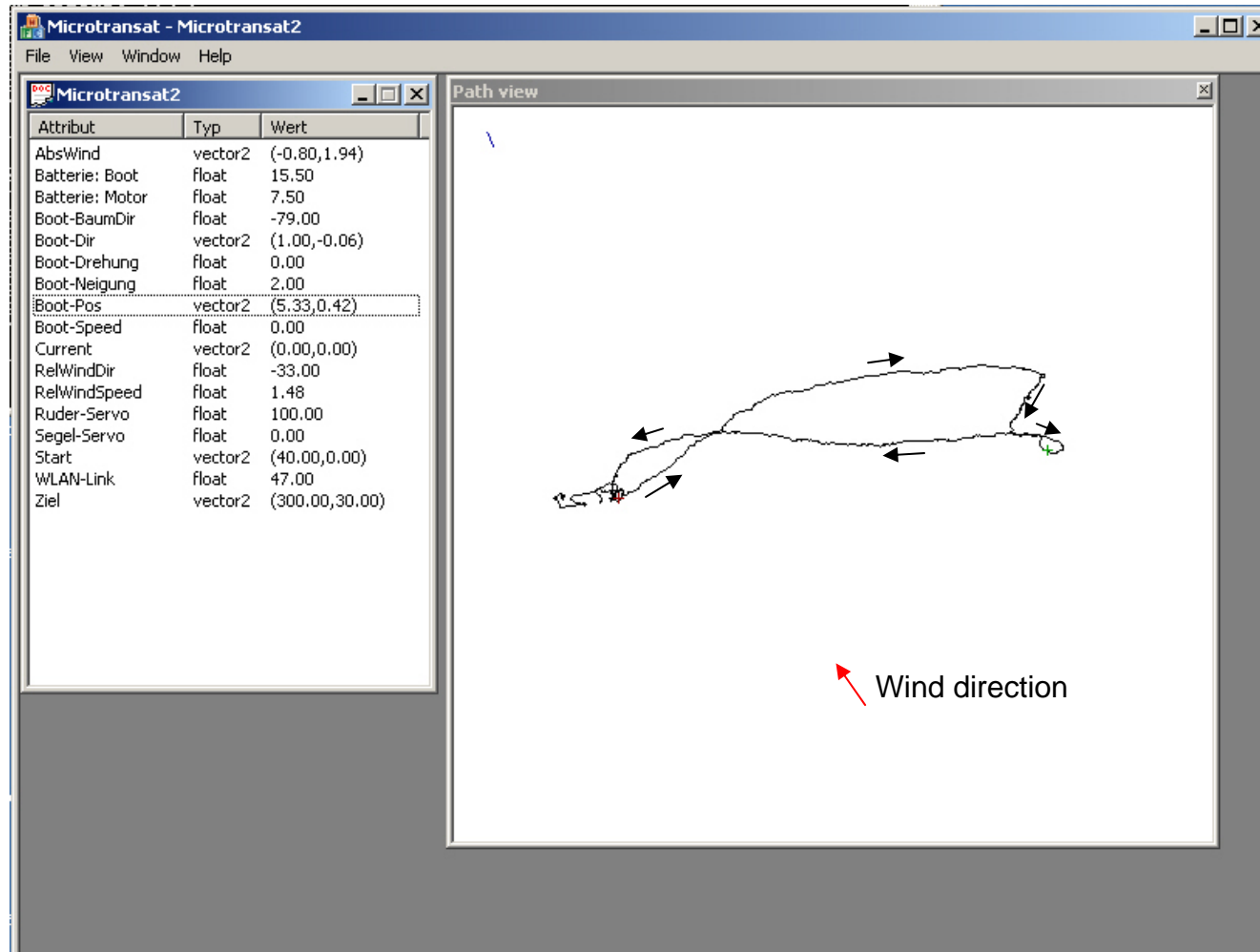
# Daemon: HW- / SW-Layer



# Coordinate Transformation



# Final Test, France 07.06.2006



## GPS Coordinates

- Buoy 1: LAT 44.08605 N / LON 1.03274 E
- Buoy 2: LAT 44.08545 N / LON 1.03623 E
- Buoy 3: LAT 44.08217 N / LON 1.03968 E