



AC34 Race Data Export Format Specification

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Abstract:

This document describes the data format for reports that are generated after a race for use by the teams and the general public. After each race, the data will be published on AmericasCup.com for use by the teams and available for download by the general public.

Status:

This document is in draft form

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1 Introduction

All of the racing yachts and mark boats are tracked using precision GPS and inertial navigations systems for all AC34 World Series Events, Challenger Selection Series, and the Match. This data is used for television graphics and race management. After each racing event, the position data is made available to the race teams and the general public for download off the Americas Cup web site. The data content will be identical for all of the teams and the public.

1.1 Terminology

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in **Error! Reference source not found.**

1.2 Units Conventions

Unless otherwise noted, angles are expressed as a navigator would express angles, 0 degrees north, 90 degrees = east. Speeds are expressed in knots. Latitude and Longitude are expressed in degrees. Longitudes east of the prime meridian are expressed as positive numbers. Latitudes north of the equator are expressed as positive numbers.

The boat positions are reported at the origin of the boat. The boat coordinate system has origin at the boat midline, aft most position and the water line. The X axis is positive towards the starboard side of the boat. Y is positive towards the bow of the boat, and z is positive up.

Heel is positive when the boat is on starboard tack (port side down). Pitch is positive when the bow is down.

1.3 File Sets

A set of files are generated for each race. The set consists of a Navigation file for each boat, and three types of XML files, boats, race, and regatta.

Navigation file

The Navigation file is a comma separated ascii file. Columns contain particular data items. Each row contain a data sample. One Navigation file will be generated for each boat. The file name will contain the hull number for the boat as well as a timestamp describing when the file was generated.

Regatta.xml file

The Regatta.xml file describes global data for the regatta such as regatta name, approximate location of the race, timezone offset, and magnetic variation.

Race.xml file

The race.xml file describes specific details for a race. It contains the course boundaries, race participants, race type, and the course description. A race may have more than one race.xml files associated with the race. This file is generated by an application operated by the Principal Race Officer. Each time the PRO makes a change to the race, such as course boundaries, a new race.xml file will be committed and sent in the log file. It is typical that the course limits will change multiple times before and during a race. It is not typical that the participants or race course description will change during the race. In the time leading up to the start, the race start time may change.

This file should be considered valid until a new version of the file is sent out.

Boats.xml file

This file is used to describe all of the boats and other entities involved in the race. Not all of the entries will be physical boats. For example, the Umpire application will have an entry in the file. One key value in the file is the SourceID. This is a unique number used by MDSS to identify data packets. Another key value is the HullNum. This number uniquely identifies the boat hull. The hull number is used as part of the Navigation file name. The Boats.xml file is used to map the hull number to boat name.

Boats.xml will not change very often. Examples of things that would cause the boats.xml file to change are changing the navigation peli case, or adding a new boat to the system.

2 Message Format

All data files are ASCII, comma delimited files or xml files. The first line of each file will contain a comma separated description of each field. The file names will have a timestamp and other descriptive names to uniquely identify the contents of each file.

Format of file names: YYYYMMDDhhmmss-NAV-HULLNUMBER.csv

Where YYYY is year

MM is month (01 -> 12)

DD is day (01-> 31)

hh is hour (00 -> 23)

mm is minute (0 -> 59)

ss is second (0 -> 59)

The timestamp represents the local time when file was started

NAV represents the file type. In this example, this is a Navigation file.

HULLNUMBER represents the boat hull number. Use the Race.xml file to associate a hull number with a boat name

Navigation

The Navigation file contains a sequence of GPS data samples taken from the boat. The nominal sample rate is 10 Hz, so there will 10 records per second in the file.

Data Field Heading	Description	Units
<i>The following fields come from the ACEA instrumentation:</i>		
Boat	Name of the boat	ASCII Text
Date	Date of the data sample, Local time	DD:MM:YYYY
Secs	Seconds from midnight, Local time	SSSS.sss
LocalTime	Local time of the data sample	HH:MM:SS.sss
Zone	Time Zone Description (ZD). UTC plus ZD = Local time	+HH
Lat	Latitude of the boat origin	Decimal Degrees, Positive North
Lon	Longitude of the boat origin	Decimal Degrees, Positive East
Hdg	Heading of the boat relative to true north.	Floating point, north = 0, east = 90.0
Heel	Heel of the boat	Positive = port down
Pitch	Pitch of the boat	Positive = bow down

COG	Course over the ground	Decimal degrees east of true north
SOG	Speed over the ground	Knots
CourseWindDirection	True wind direction of the course as used for television and internet media	Decimal degrees east of true north
CourseWindSpeed	Wind speed of the course as used for television and internet media	Knots
<i>The following fields come from each yacht/mark's instruments:</i>		
yHdg * ¹	Heading of boat – the orientation of the hulls rather than course over ground or through the water	Degrees, true north = 0.0, east = 90.0
ySpeed * ¹	Speed of boat over water	Knots
yTWS * ¹	True Wind Speed	Knots
yTWD * ¹	True Wind Direction. Relative to true north.	Floating point, north = 0, east = 90.0
yAWS * ¹	Apparent Wind Speed	Knots
yAWA * ¹	Apparent Wind Angle	Degrees Positive on starboard tack
yTWA * ¹	True Wind Angle.	Degrees Positive on starboard
ySOG	Speed over the ground	Knots
yCOG	Course of the boat over the ground relative to true north.	Floating point, north = 0, east = 90.0
yRudder * ¹	Rudder Angle.	Degrees. Value will be zero when actual rudder angle is less than 5 degrees. Above 5 degrees, resolution is 0.1 degrees. Positive when rudder is angled to turn boat to port.

Notes:

*¹ The following table shows the validity of these data fields for different boat types

Data Item	Mark Boat			AC45			AC72		
	Valid	Relative to Water	Relative to Ground	Valid	Relative to Water	Relative to Ground	Valid	Relative to Water	Relative to Ground
yHdg	No			No			Yes		
ySpeed	No			No			Yes	X	
yTWS	Yes		X	No			Yes	X	
yTWD	Yes		X	No			Yes	X	

yAWS	Yes			No			Yes		
yAWA	Yes			No			Yes		
yTWA	Yes		X	No			Yes	X	
ySOG	No			No			Yes		X
yCOG	No			No			Yes		X
yRudder	No			No			Yes		

The data for each boat will be contained in a comma-separated value (CSV) file. A file will exist for each boat. The file names will follow a convention that describes the file type, time the file was created, and boat name

Race Events

This file will contain events that happen during the race. The file is formatted as a .csv file (comma-separated values) with four or more fields. The first line of the file contains a text header describing each field.

Header	Description	Format/units
Boat	Name of the boat	ASCII Text
Race	ID of the race	8 digits: yymmddnn, the date and number of the race
Date	Date of the data sample, Local time	DD:MM:YYYY
Secs	Seconds from midnight, Local time	SSSS.sss
LocalTime	Local time of the event	HH:MM:SS.sss
Zone	Time Zone Description (ZD). UTC plus ZD = Local time	+HH
Event	Event Code that describes what event happened	Alphanumeric text
Opt1	Optional field 1	See description below
Opt2	Optional field 2	See description below

The following table describes the possible values for the Event Code field.

Event Code	Description	Option Data fields
<i>These events apply to a race, and include its ID in the RaceID field:</i>		
RaceStartTimeAnnounced	Time that the race is expected to start	Race start time. Optional field 1 is the date and optional field 2 is the local time.
RacePostponed	Start has been put off indefinitely	
RaceAbandoned	The race has been cancelled. May happen before or after the start.	
RaceStarted	Time when the race was started	
RaceTerminated	The PRO has terminated the race	
<i>These events apply to a specific boat, and include its name in the Boat field:</i>		
EarlyEntry	Boat has entered the starting area earlier than 3:00 before the start for the port-entry boat, or 2:45 for the starboard boat.	

LateEntry	Boat was not on the prestart side 1 minute before the race start	
MarkRounding	Time that a boat rounded a mark	Mark number (i.e. "1" for the first mark after starting, then "2", etc)
BoatStarted	Time that a boat crossed the start line	
CrossedFinish	Time that a boat crossed the finish line	
BoatRetired	Time that a boat retires from the race	
OCS	The distance that the boat was OCS at the start time of the race	Distance over the line in meters
ClearBehindStart	The boat has successfully crossed back over the starting line after being OCS	
NoPenalty	Umpire has ruled in response to a protest that there was no penalty.	
Penalty44_2a	Umpire assigned a 44.2a penalty	
Penalty44_2b	Umpire cleared a 44.2b penalty	
PenaltyCleared	The boat has completed one of its penalty obligations.	
PenaltyOffset	The boat is relieved of one of its penalty obligations due to an infraction by another yacht	
BFlag	Yacht pressed the B flag button	
YFlag	Yacht pressed the Y flag button	
YouTack	Yacht pressed the You Tack button	
Room	Yacht pressed the Room to Tack button	
Finished	Official finish time for this yacht from the Principal Race Officer. This may differ slightly from the time reported in the CrossedFinish event.	
DSQ	The boat has been disqualified	
DNS	The boat has been scored DNS	
DNF	The boat has been scored DNF	
Message	A text message has been sent from named participant, e.g. PRO or Ump, to some group of recipients – yachts, marks, marshals, etc.	Opt field 1 – recipient groups; opt field 2 – text of message
RaceChanged	A change was made to the course, limits, mark boat assignments, or race participants. Read the corresponding time-stamped Race.xml file for details.	
BoatsChanged	A change was made to the list of boats	

	<p>or officials participating in the races, their names, or geometric shapes. Read the corresponding time-stamped Boats.xml file for details.</p>	
RegattaChanged	<p>A change was made to the name, location, time zone, or other details of the race venue. Read the corresponding time-stamped Regatta.xml file for details.</p>	
VMxActive	<p>The yacht is currently paying off a VMx penalty</p>	
BoBActive	<p>The yacht is currently paying off a Boat on Boat penalty</p>	

3 XML Message Formats

This section describes the format of various XML files used to communicate configuration information

3.1 Regatta.xml

The Regatta xml file describes the global attributes for a regatta. This file tends to be the same for an entire regatta. It is created from the ACDB database and distributed by the MDSS.

```
<?xml version="1.0" encoding="utf-8"?>
<RegattaConfig>
  <RegattaID>3</RegattaID>
  <RegattaName>New Zealand Test</RegattaName>
  <CourseName>North Head</CourseName>
  <CentralLatitude>-36.82791529</CentralLatitude>
  <CentralLongitude>174.81218919</CentralLongitude>
  <CentralAltitude>0.00</CentralAltitude>
  <UtcOffset>12</UtcOffset>
  <MagneticVariation>14.1</MagneticVariation>
</RegattaConfig>
```

RegattaID – The RegattaID is a unique number used in the database as a key to the regatta

RegattaName – The name of the regatta

RaceID – The RaceID is a unique number used as a key in the database for the race

CourseName – Name of the race course

CentralLatitude – Latitude in vicinity of the center of the race course.

CentralLongitude – Longitude in the vicinity of the center of the race course

CentralAltitude – Altitude in the vicinity of the center of the race course

UtcOffset – Offset from UTC for the race.

MagneticVariation – Local Magnetic Variation

3.2 Boats.xml

The Boats xml file describes the boats and other systems configured in the system. It contains two main sections, BoatShapes and Boats. The BoatShapes section describes the outline of the boats. Each section has a list of vertices that describe the outline. Units are meters. The next section, Boats, describe the physical and functional attributes of a boat or application.

Each boat has a tag called ShapeID. This ID is used as a link into the BoatShapes to associate a boat shape with the boat.

```
<BoatConfig>
  <Modified>2012-01-25T18:36:56-08:00</Modified>
  <Version>12</Version>
  <Settings>
    <RaceBoatType Type="AC45" />
  </Settings>
</BoatConfig>
```

```

<BoatDimension BoatLength="14.019" HullLength="13.449" />
<ZoneSize MarkZoneSize="40.347" CourseZoneSize="40.347" />
<ZoneLimits Limit1="200" Limit2="100" Limit3="40.347" Limit4="0" Limit5="-100" />
</Settings>
<BoatShapes>
  <BoatShape ShapeID="0" />
  <BoatShape ShapeID="7">
    <Vertices>
      <Vtx Seq="1" Y="0" X="-3.323" />
      <Vtx Seq="2" Y="13.449" X="-3.075" />
      <Vtx Seq="3" Y="14.019" X="0" />
      <Vtx Seq="4" Y="13.449" X="3.075" />
      <Vtx Seq="5" Y="0" X="3.323" />
    </Vertices>
    <Catamaran>
      <Vtx Seq="1" Y="1.769" X="-2.752" />
      <Vtx Seq="2" Y="0" X="-2.813" />
      <Vtx Seq="3" Y="0" X="-3.34" />
      <Vtx Seq="4" Y="5.351" X="-3.46" />
      <Vtx Seq="5" Y="10.544" X="-3.387" />
      <Vtx Seq="6" Y="13.449" X="-3.075" />
      <Vtx Seq="7" Y="10.851" X="-2.793" />
      <Vtx Seq="8" Y="6.669" X="-2.699" />
      <Vtx Seq="9" Y="6.669" X="2.699" />
      <Vtx Seq="10" Y="10.851" X="2.793" />
      <Vtx Seq="11" Y="13.449" X="3.075" />
      <Vtx Seq="12" Y="10.544" X="3.387" />
      <Vtx Seq="13" Y="5.351" X="3.46" />
      <Vtx Seq="14" Y="0" X="3.34" />
      <Vtx Seq="15" Y="0" X="2.813" />
      <Vtx Seq="16" Y="1.769" X="2.752" />
    </Catamaran>
    <Bowsprit>
      <Vtx Seq="1" Y="6.669" X="-0.2" />
      <Vtx Seq="2" Y="11.377" X="-0.2" />
      <Vtx Seq="3" Y="14.019" X="0" />
      <Vtx Seq="4" Y="11.377" X="0.2" />
      <Vtx Seq="5" Y="6.669" X="0.2" />
    </Bowsprit>
    <Trampoline>
      <Vtx Seq="1" Y="2" X="-2.699" />
      <Vtx Seq="2" Y="6.438" X="-2.699" />
      <Vtx Seq="3" Y="6.438" X="2.699" />
      <Vtx Seq="4" Y="2" X="2.699" />
    </Trampoline>
  </BoatShape>
  <BoatShape ShapeID="8">
    <Vertices>
      <Vtx Seq="1" Y="0" X="-2.659" />
      <Vtx Seq="2" Y="18.359" X="-2.659" />
      <Vtx Seq="3" Y="18.359" X="2.659" />
      <Vtx Seq="4" Y="0" X="2.659" />
    </Vertices>
  </BoatShape>
  <BoatShape ShapeID="10">
    <Vertices>
      <Vtx Seq="1" Y="0" X="-1.278" />
      <Vtx Seq="2" Y="8.876" X="-1.278" />
      <Vtx Seq="3" Y="8.876" X="1.278" />
      <Vtx Seq="4" Y="0" X="1.278" />
    </Vertices>
  </BoatShape>
  <BoatShape ShapeID="12">
    <Vertices>
      <Vtx Seq="1" Y="0" X="-1.1" />
      <Vtx Seq="2" Y="8.3" X="-1.1" />
      <Vtx Seq="3" Y="8.3" X="1.1" />
      <Vtx Seq="4" Y="0" X="1.1" />
    </Vertices>
  </BoatShape>
</BoatShapes>

```

```

<BoatShape ShapeID="13">
  <Vertices>
    <Vtx Seq="1" Y="0" X="-0.75" />
    <Vtx Seq="2" Y="3" X="-0.75" />
    <Vtx Seq="3" Y="3" X="0.75" />
    <Vtx Seq="4" Y="0" X="0.75" />
  </Vertices>
</BoatShape>
</BoatShapes>
<Boats>
  <Boat Ack="1" IPAddress="172.20.1.121" Type="RC" SourceID="121" ShapeID="8" StoweName="PRO"
ShortName="PRO" BoatName="Regardless" HullNum="RG01" Skipper="Alistair McRae" Flag="Stowe,Mark"
PeliID="17" RadioIP="172.20.2.121">
  <GPSposition Z="6.84" Y="7.8" X="0" />
  <FlagPosition Z="0" Y="7.8" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.122" Type="Mark" SourceID="122" ShapeID="10" StoweName="CON"
ShortName="Constellation" BoatName="Constellation" HullNum="LC05" Skipper="Gabriel Fernandez" Flag="Mark"
PeliID="18" RadioIP="172.20.2.122">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.123" Type="Mark" SourceID="123" ShapeID="10" StoweName="MIS"
ShortName="Mischief" ShorterName="MCHF" BoatName="Mischief" HullNum="LC04" Skipper="Piet Van Os"
Flag="Mark" PeliID="19" RadioIP="172.20.2.123">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.124" Type="Mark" SourceID="124" ShapeID="10" StoweName="ATA"
ShortName="Atalanta" BoatName="Atalanta" HullNum="LC03" Skipper="Joey Pasquali" Flag="Mark" PeliID="20"
RadioIP="172.20.2.124">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.125" Type="Mark" SourceID="125" ShapeID="10" StoweName="VOL"
ShortName="Volunteer" ShorterName="VLTR" BoatName="Volunteer" HullNum="LC02" Skipper="George Santon"
Flag="Mark" PeliID="21">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.126" Type="Mark" SourceID="126" ShapeID="10" StoweName="DEF"
ShortName="Defender" BoatName="Defender" HullNum="LC13" Skipper="Kyle Gunderson" Flag="Mark" PeliID="22">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.127" Type="Mark" SourceID="127" ShapeID="10" StoweName="REL"
ShortName="Reliance" BoatName="Reliance" HullNum="LC12" Skipper="Stan Gibbs" Flag="Mark" PeliID="23">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />
  <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
</Boat>
  <Boat Ack="1" IPAddress="172.20.1.128" Type="Mark" SourceID="128" ShapeID="10" StoweName="SHA"
ShortName="Shamrock" BoatName="Shamrock" HullNum="LC01" Skipper="Stan Gibbs" Flag="Mark" PeliID="24"
RadioIP="172.20.2.128">
  <GPSposition Z="5.334" Y="3.804" X="0" />
  <FlagPosition Z="0" Y="3.426" X="0" />
  <NavDevice Type="NovAtelGps" />

```

```

    <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.131" Type="Mark" SourceID="131" ShapeID="10" StoweName="COL"
ShortName="Columbia" BoatName="Columbia" HullNum="LC06" Skipper="Kyle Gundersen" Flag="Stowe,Mark"
PeliID="27">
    <GPSposition Z="5.334" Y="3.804" X="0" />
    <FlagPosition Z="0" Y="3.426" X="0" />
    <NavDevice Type="NovAtelGps" />
    <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.132" Type="Marshall" SourceID="132" ShapeID="12" StoweName="RGR"
ShortName="Ranger" BoatName="Ranger" HullNum="XR04" Skipper="James Chapman" Flag="Stowe,Mark" PeliID="28">
    <GPSposition Z="5.17" Y="3.804" X="0" />
    <FlagPosition Z="0" Y="0" X="0" />
    <NavDevice Type="NovAtelGps" />
    <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.130" Type="Umpire" SourceID="130" ShapeID="12" StoweName="VIG"
ShortName="Vigilant" BoatName="Vigilant" HullNum="XR02" Flag="Stowe" PeliID="26" RadioIP="172.20.2.130">
    <GPSposition Z="5.17" Y="3.804" X="0" />
    <NavDevice Type="NovAtelGps" />
    <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.135" Type="Umpire" SourceID="135" ShapeID="13" StoweName="JT1"
ShortName="Jet1" BoatName="Jet Ski 1" HullNum="JT01" PeliID="53">
    <GPSposition Z="0.77" Y="1" X="0" />
    <NavDevice Type="L1Gps" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.136" Type="Umpire" SourceID="136" ShapeID="13" StoweName="JT2"
ShortName="Jet2" BoatName="Jet Ski 2" HullNum="JT02" PeliID="54">
    <GPSposition Z="0.77" Y="1" X="0" />
    <NavDevice Type="L1Gps" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.137" Type="Umpire" SourceID="137" ShapeID="13" StoweName="JT3"
ShortName="Jet3" BoatName="Jet Ski 3" HullNum="JT03" PeliID="56">
    <GPSposition Z="0.77" Y="1" X="0" />
    <NavDevice Type="L1Gps" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.129" Type="Marshall" SourceID="129" ShapeID="12" StoweName="WEA"
ShortName="Weatherly" BoatName="Weatherly" HullNum="XR01" Skipper="Mattias Dahlstrom" Flag="Mark"
PeliID="25" RadioIP="172.20.2.129">
    <GPSposition Z="5.17" Y="3.804" X="0" />
    <FlagPosition Z="0" Y="0" X="0" />
    <NavDevice Type="NovAtelGps" />
    <BoatInstruments Type="MaretronWindSonic" CompOff="180" WindOff="0" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.101" Type="Yacht" SourceID="101" ShapeID="7" StoweName="KOR"
ShortName="TEAM KOREA" ShorterName="TKOR" BoatName="TEAM KOREA" HullNum="AC4501" Skipper="Chris Draper"
Country="KOR" Flag="Stowe" PeliID="2">
    <PolarFile Name="YachtIDpolar.txt" />
    <GPSposition Z="1.738" Y="0.625" X="0.001" />
    <MastTop Z="21.496" Y="4.233" X="0" />
    <FlagPosition Z="0" Y="0" X="0" />
    <NavDevice Type="NovAtelSpan" />
    <VehicleToBodyRotation Z="180" Y="0" X="0" />
    <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
    <ImuOrientation Mode="4" />
  </Boat>
  <Boat Ack="1" IPAddress="172.20.1.102" Type="Yacht" SourceID="102" ShapeID="7" StoweName="AR1"
ShortName="ARTEMIS" ShorterName="ARTR" BoatName="ARTEMIS" HullNum="AC4502" Skipper="Terry Hutchinson"
Country="SWE" Flag="Stowe" PeliID="3">
    <PolarFile Name="YachtIDpolar.txt" />
    <GPSposition Z="1.732" Y="0.62" X="0.002" />
    <MastTop Z="21.496" Y="4.233" X="0" />
    <FlagPosition Z="0" Y="0" X="0" />
    <NavDevice Type="NovAtelSpan" />
    <VehicleToBodyRotation Z="180" Y="0" X="0" />
    <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
    <ImuOrientation Mode="4" />
  </Boat>

```

```

<Boat Ack="1" IPAddress="172.20.1.103" Type="Yacht" SourceID="103" ShapeID="7" StoweName="TNZ"
ShortName="ETNZ" ShorterName="ETNZ" BoatName="EMIRATES TEAM NZ" HullNum="AC4503" Skipper="Dean Barker"
Country="NZL" Flag="Stowe" PeliID="4">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.663" Y="0.561" X="-0.032" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
  <ImuOrientation Mode="4" />
</Boat>
<Boat Ack="1" IPAddress="172.20.1.104" Type="Yacht" SourceID="104" ShapeID="7" StoweName="OR4"
ShortName="OR SPITHILL" ShorterName="OR-S" BoatName="ORACLE RACING SPITHILL" HullNum="AC4504"
Skipper="James Spithill" Country="USA" Flag="Stowe" PeliID="5">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.724" Y="0.612" X="-0.004" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
  <ImuOrientation Mode="4" />
</Boat>
<Boat Ack="1" IPAddress="172.20.1.105" Type="Yacht" SourceID="105" ShapeID="7" StoweName="OR5"
ShortName="OR COUTTS" ShorterName="OR-C" BoatName="ORACLE RACING COUTTS" HullNum="AC4505" Skipper="Russel
Coutts" Country="USA" Flag="Stowe" PeliID="6">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.725" Y="0.614" X="0.013" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
  <ImuOrientation Mode="4" />
</Boat>
<Boat Ack="1" IPAddress="172.20.1.107" Type="Yacht" SourceID="107" ShapeID="7" StoweName="NRG"
ShortName="ENERGY TEAM" ShorterName="ENRG" BoatName="ENERGY TEAM" HullNum="AC4507" Skipper="Loick Peyron"
Country="FRA" Flag="Stowe" PeliID="8">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.691" Y="0.55" X="0" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
  <ImuOrientation Mode="4" />
</Boat>
<Boat Ack="1" IPAddress="172.20.1.108" Type="Yacht" SourceID="108" ShapeID="7" StoweName="GCR"
ShortName="GREEN COMM" ShorterName="GCRC" BoatName="GREEN COMM" HullNum="AC4510" Skipper="Vissilij Zbogor"
Country="ESP" Flag="Stowe" PeliID="9">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.691" Y="0.584" X="-0.008" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />
  <ImuOrientation Mode="4" />
</Boat>
<Boat Ack="1" IPAddress="172.20.1.109" Type="Yacht" SourceID="109" ShapeID="7" StoweName="ALF"
ShortName="ALEPH" ShorterName="ALPH" BoatName="ALEPH" HullNum="AC4509" Skipper="Bertrand Pace"
Country="FRA" Flag="Stowe" PeliID="10">
  <PolarFile Name="YachtIDpolar.txt" />
  <GPSposition Z="1.73" Y="0.617" X="-0.001" />
  <MastTop Z="21.496" Y="4.233" X="0" />
  <FlagPosition Z="0" Y="0" X="0" />
  <NavDevice Type="NovAtelSpan" />
  <VehicleToBodyRotation Z="180" Y="0" X="0" />
  <InsCoordinate Z="0.133" Y="1.798" X="3.21065" />

```

```

    <ImuOrientation Mode="4" />
  </Boat>
  <Boat Ack="0" IPAddress="172.20.1.140" Type="Helicopter" SourceID="140" ShapeID="0" StoweName="HLI"
ShortName="HEL" BoatName="Helicopter" PeliID="30" />
  <Boat Ack="0" IPAddress="172.20.1.200" Type="ClientData" SourceID="200" ShapeID="0" StoweName="SFX"
ShortName="SailFX" BoatName="SailFX" Flag="PenLine, PenDist" />
  <Boat Ack="1" IPAddress="172.20.1.201" Type="ProApp" SourceID="201" ShapeID="0" StoweName="PRO"
ShortName="PROAPP" BoatName="PRO John Craig" Flag="YachtEvents" />
  <Boat Ack="1" IPAddress="172.20.1.202" Type="MDSS" SourceID="202" ShapeID="0" StoweName="MDS"
ShortName="MDSS" BoatName="MDSS" />
  <Boat Ack="1" IPAddress="172.20.1.203" Type="ProApp" SourceID="203" ShapeID="0" StoweName="PRO"
ShortName="PRO" BoatName="PRO BACKUP" Flag="YachtEvents" />
  <Boat Ack="0" IPAddress="172.20.1.211" Type="ClientData" SourceID="211" ShapeID="0" StoweName="LBI"
ShortName="LBI" BoatName="LBI" Flag="Chatter, Rounding, YachtEvents" />
  <Boat Ack="0" IPAddress="172.20.1.214" Type="ClientData" SourceID="214" ShapeID="0" StoweName="ARL"
ShortName="ARL4" BoatName="ARL 2D 4" />
  <Boat Ack="0" IPAddress="172.20.1.215" Type="ClientData" SourceID="215" ShapeID="0" StoweName="ARL"
ShortName="ARL5" BoatName="ARL 3D 1" />
  <Boat Ack="1" IPAddress="172.20.1.223" Type="UmpApp" SourceID="223" ShapeID="0" StoweName="UMP"
ShortName="UMPAPP3" ShorterName="UMP3" BoatName="UMP Mike LT" />
</Boats>
</BoatConfig>

```

BoatShapes – The BoatShapes section contain a set of BoatShape objects. Each BoatShape object describes the shape of a boat.

BoatShape – The BoatShape tag contains a ShapeID value. This ID is referenced in the Boats section to associate a boat shape with a boat. The list of vertices have an assume start vertex at the boat origin, 0,0. The shape must be described clockwise. One of the boat shapes will have tags for **Catamaran**, **Bowsprit**, and **Trampoline**. These shapes describe the approximate shape of the AC45 or AC72 race yacht.

Boats – The Boats tag lists that boats that are tracked during the race. It includes the committee boat, mark boats, and racing yachts

Boat – The boat tag describes attributes of the boats.

SourceID – SourceID is the number in the mdMsg header used to identify the source of a message

ShapeID – ShapeID is the reference ID to the BoatShape in the BoatShapes tag.

BoatName – Official name of the boat. Normally the name printed on the boat

ShortName – Abbreviated name for the boat.

StoweName – Abbreviation to use when sending messages to the Stowe Display. If this tag is missing, use the **ShortName** tag.

HullNum – Unique hull number for the boat. This number will follow the physical boat hull, regardless of team or owner..

Ack – This is used internally to the MDSS system to tell the MDSS system if an application level acknowledgement is required for certain messages.

Skipper – Name of the boat skipper.

Country – Three letter abbreviation of the team country.

IPAddress – Ethernet address for the computational device in the boat or application.

Type – Type of device. Valid names are

Yacht
RC
Mark

Pin
Chase
Medical
Marshall
Umpire
UmpApp
ProApp
Weather
Helicopter
MDSS

Flag – Set of flags that describes functions and attributes of the boat. Valid flags are:

Stowe – This boat has a Stowe display
Mark – This boat is used as a mark boat

NavDevice – Type of navigation device in the boat. Valid values are NovatelGps, NovAtelSpan, L1Gps, L1Dgps, or AIRINS

BoatInstruments – Type of boat instrumentation. Valid types are WTP, WTP2, BG, MaretronWindSonic.

InsCoordinate – Location of the INS relative to the boat coordinate system

ImuOrientation – Number that represents the orientation of the IMU relative to the boat. See documentation on the navigation device

VehicleToBodyRotation – Angular orientation of IMU relative to the vehicle. See documentation on the navigation device for units and conventions

GPSposition – Location of the GPS Antenna relative to the boat coordinate system

FlagPosition – Location of the coordinate on the boat where the position should be reported relative to the boat coordinate system. This is used for the mark boats to indicate where the flag or center of the boat is.

3.3 Race.xml

The Race.xml file describes the boats and course configuration for a race. This file is created on the committee boat by an application operated by the principal race officer.

```
<?xml version="1.0" encoding="utf-8"?>
<Race>
  <RaceID>11080703</RaceID>
  <RaceType>Match</RaceType>
  <RaceStartTime Time="2011-08-06T13:30:00" Postpone="false" />
  <Participants>
    <Yacht SourceID="107" Entry="Port" />
    <Yacht SourceID="108" Entry="Stbd" />
  </Participants>
  <Course>
    <CompoundMark CompoundMarkID="1" Name="StartLine">
      <Mark SeqID="1" Name="PR0" TargetLat="-36.83" TargetLng="174.83" SourceID="101" />
      <Mark SeqID="2" Name="PIN" TargetLat="-36.84" TargetLng="174.81" SourceID="102" />
    </CompoundMark>
    <CompoundMark CompoundMarkID="2" Name="M1">
      <Mark Name="M1" TargetLat="-36.63566590" TargetLng="174.88543944" SourceID="103" />
    </CompoundMark>
    <CompoundMark CompoundMarkID="3" Name="M2">
      <Mark Name="M2" TargetLat="-36.83" TargetLng="174.80" SourceID="102" />
    </CompoundMark>
  </Course>
</Race>
```

```

</CompoundMark>
<CompoundMark CompoundMarkID="4" Name="Gate">
  <Mark SeqID="1" Name="G1" TargetLat="-36.63566590" TargetLng="174.97205159" SourceID="104" />
  <Mark SeqID="2" Name="G2" TargetLat="-36.64566590" TargetLng="174.98205159" SourceID="105" />
</CompoundMark>
</Course>
<CompoundMarkSequence>
  <Corner SeqID="1" CompoundMarkID="1" Rounding="SP" ZoneSize="3" />
  <Corner SeqID="2" CompoundMarkID="2" Rounding="Port" ZoneSize="3" />
  <Corner SeqID="3" CompoundMarkID="3" Rounding="Stbd" ZoneSize="6" />
  <Corner SeqID="4" CompoundMarkID="4" Rounding="PS" ZoneSize="6" />
  <Corner SeqID="5" CompoundMarkID="1" Rounding="SP" ZoneSize="3" />
</CompoundMarkSequence>
<CourseLimit>
  <Limit SeqID="1" Lat="-36.8325" Lon="174.8325"/>
  <Limit SeqID="2" Lat="-36.82883" Lon="174.81983"/>
  <Limit SeqID="3" Lat="-36.82067" Lon="174.81983"/>
  <Limit SeqID="4" Lat="-36.811" Lon="174.8265"/>
  <Limit SeqID="5" Lat="-36.81033" Lon="174.83833"/>
  <Limit SeqID="6" Lat="-36.81533" Lon="174.8525"/>
  <Limit SeqID="7" Lat="-36.81533" Lon="174.86733"/>
  <Limit SeqID="8" Lat="-36.81633" Lon="174.88217"/>
  <Limit SeqID="9" Lat="-36.83383" Lon="174.87117"/>
  <Limit SeqID="10" Lat="-36.83417" Lon="174.84767"/>
</CourseLimit>
</Race>

```

RaceID – RaceID is a unique number for each race. The number is typically created on the Expedition program. The ID is created using the following format. YYMMDDNN where YY is the last two digits of the year, MM is the Month, DD is the Day, and NN is the race number.

RaceType – Type of race (Match or Fleet)

RaceStartTime – There are two attributes for the RaceStartTime. ‘Time’ is the UTC time that the race will start. ‘Postpone’ is true or false. If it is false, the Time describes the time when the race will start (or started). If ‘Postpone’ is true, the race is postponed, and the ‘Time’ field is invalid.

Participants – This section describes what race yachts are in the race. For match races, the Entry tag describes what side of the course the boats start on (Port or Stbd). The SourceID describes what boat is participating

Course – This section describes the race course. Within this tag, there is a sequence of ‘CompoundMark’s. Each CompoundMark has a Name used to describe the compound mark. The is a symbolic name and does not necessarily describe a particular boat. A compound mark is either a single mark or a pair of marks that make up the starting line or the gate. Each boat in a CompoundMark has a ‘Name’ tag. The name is the name that written on the stem of the boat. The ‘CompoundMarkID’ is used as a reference in the CompoundMarkSequence tag. Marks within the CompoundMark tag can optionally have a TargetLat and TargetLng tag to describe the target location for a mark boat.

When a CompoundMark has two boats (start line, gate, finish line), the TargetLat and TargetLon will be the same.

CompoundMarkSequence – This section describes the sequence of mark roundings. The SeqID tag describes the order. The CompoundMarkID tag is associated with the CompoundMarkID tag in the Course section. The Rounding tag describes how the mark is passed. Valid values are “Port”, “Stbd”, “SP”, or “PS”. Port means that the mark should be rounded to port, Stbd means that the mark should be rounded to starboard. SP means that the boat within the compound mark with the SeqID of 1 should be rounded

to starboard and the boat within the compound mark with the SeqID of 2 should be rounded to port. PS means the opposite of SP.

The CompoundMarkSequence is slightly different in a Match race when an entry boat is utilized. The first CompoundMarkSequence will reference a single boat with and the rounding will be Port or Starboard. This is the entry mark. The second CompoundMarkSequence will be the startline.

ZoneSize – Size of the zone around a mark in boatlengths.

CourseLimit – This section describes the course limits. The sequence of 'Limit' tags must be clockwise.

Appendix A. Revision History

Revision	Date	Editor	Changes Made
0.01	3/23/2011	Ken Milnes	Initial Draft
1.00	17 June 2011	Ken Milnes	Change the XML specifications. Add course wind speed and course wind direction
1.01	28 June 2011	Tim Heidmann	Add yHdg field to boat file, add LocalTime and Race to event file. Add Message, RaceChanged, BoatsChanged, and RegattaChanged events.
1.02	29 Aug 2011	Ken Milnes	Add additional documentation.
1.03	26 Oct 2011	Ken Milnes	Document formatting changes
1.04	19 Sept 2012	Tim Heidmann	Create CrossedFinish event
1.05	27 Mar 2012	Ken Milnes	Update boats.xml. Add BoB and VMx penalty events