
Second Spectrum: Premier League – Tracking and Metadata Output Formats

File Documentation Details
Version 0.9

Version History

Version	Date	Notes
v0.1	15/4/19	Initial Version
v0.2	8/5/19	Clarification on timezone
v0.3	17/6/19	Added timestamp to frames
v0.4	12/7/19	Updated metadata formats
v0.5	2/8/19	Updated metadata format to use wall clock for period starts
v0.6	5/8/19	Add player jersey numbers to .jsonl and .xml tracks formats
v0.7	17/10/19	Add end-of-period signals
v0.8	18/5/20	Add attack directions, score, and half start frame indices to .json metadata
v0.9	24/6/21	Adjust the playerId to 2S and added optald for tracking. Removed .dat as an offering.

Overview

Second Spectrum will continue to deliver metadata and tracking data in the existing formats of .xml for tracking and .xml for the metadata file.

Additionally, both files will be delivered in .json formatting which is described below.

Output Format

Output	Format	Message Contents	Notes
METADATA	.json, .xml	Games, players, teams mappings	
TRACKING	Line-delimited .jsonl ¹ , .xml	XYZ positions of <ul style="list-style-type: none">• Players (22)• Ball	One message is generated per frame of input video.
SIGNALS	Line-delimited .jsonl	End of period/game	Generated when a period/game ends.

¹A line-delimited JSON file consists of

- one JSON message per line
- successive messages separated by a single linefeed ("\n").

Game Metadata

Metadata files in .json and .xml formats will be available via DVMS and in respective S3 buckets (bucket locations to be delivered in the future) for all games.

Example Game Metadata Object in JSON

```
{
  "ssiId": "1dc5d461-a792-428c-bdbc-f68efdb48c78",
  "optaId": "987892",
  "optaUuid": "cfxn9tsiqdnbxiz9fp6fzzkoa",
  "description": "BOU - NEW : 2019-3-16",
  "homeSsiId": "a8426f42-abc8-4224-a7b9-8df69a5b56a2",
  "homeOptaId": "91",
  "homeOptaUuid": "1pse9ta7a45pi2w2grjim70ge",
  "awaySsiId": "3f8f4e99-4722-4925-bf42-54c55e4a4faa",
  "awayOptaId": "4",
  "awayOptaUuid": "7vn2i2kd35zuetw6b38gw9jsz",
  "startTime": 1552741200000,
  "year": 2019,
  "month": 3,
  "day": 16,
  "homeScore": 2,
  "awayScore": 2,
  "venueId": "8vnu2g41orfaa25n2djgrv4jm",
  "fps": 25.0,
  "periods": [
    {
      "number": 1,
      "startFrameIdx": 1545836408396,
      "endFrameIdx": 1545839180356,
      "startFrameIdx": 70619,
      "endFrameIdx": 14520,
      "homeAttPositive": true
    },
    ... second half omitted ...
  ],
  "homePlayers": [
    {
      "ssiId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
      "optaId": "171129",
      "optaUuid": "dkt9892ixwnz1bkmgileo71sl",
      "name": "D. Rico",
      "number": "21"
    }
  ]
}
```

```

    },
    ... other players omitted ...
  ],
  "awayPlayers": [
    {
      "ssiId": "00aa3b30-12a8-4163-9fed-fe58dc3bce8c",
      "optaId": "151119",
      "optaUuid": "269gnyszrb8ezl57m1ampsdlh",
      "name": "D. Yedlin",
      "number": "22"
    },
    ... other players omitted ...
  ],
  "pitchLength": 104.8512,
  "pitchWidth": 67.9704
}

```

PL Game Metadata Object

Field	Type	Description
ssild	String	Second Spectrum Inc, game ID <pre>"ssiId": "1dc5d461-a792-428c-bdbc-f68efdb48c78",</pre>
optald	String	Opta game ID <pre>"id": "987892",</pre>
optaUuid	String	Opta perform ID <pre>"optaUuid": "cfxn9tsiqdnbxiz9fp6fzzkoa",</pre>
description	String	{Home} - {Away}: YEAR-MONTH-DAY <pre>"description": "BOU - WAT : 2019-1-2",</pre>
homeSsild	String	Second Spectrum Inc, ID for the home team <pre>"homeSsild": "1pse9ta7a45pi2w2grjim70ge",</pre>
homeOptald	String	Opta ID for the home team

		<pre>"homeOptaId": "91",</pre>
homeOptaUuid	String	Opta perform ID for the home team <pre>"homeOptaUuid": "1pse9ta7a45pi2w2grjim70ge",</pre>
awaySsiId	String	Second Spectrum Inc, ID for the away team <pre>"awaySsiId": "3f8f4e99-4722-4925-bf42-54c55e4a4faa",</pre>
awayOptaId	String	Opta ID for the away team <pre>"awayOptaId": "4",</pre>
awayOptaUuid	String	Opta perform ID for the away team <pre>"awayOptaUuid": "7vn2i2kd35zuetw6b38gw9jsz",</pre>
startTime	Int	Start time of the game, encoded as the number of milliseconds since January 1, 1970, GMT <pre>"startTime": 1546462800000,</pre>
year	Int	The game's year <pre>"year": 2019,</pre>
month	Int	The game's month <pre>"month": 1,</pre>
day	Int	The game's day <pre>"day": 2,</pre>
homeScore	Int	The number of goals scored by the home team <pre>"homeScore": 2,</pre>

awayScore	Int	The number of goals scored by the away team <pre>"awayScore": 2,</pre>
venueId	String	Opta venue Id <pre>"venueId": "8vnu2g41orfaa25n2djgrv4jm",</pre>
fps	Float (1/seconds)	Number of frames per second <pre>"fps": 25.0,</pre>
periods	JSON Array of period objects	Details on when the periods start and end in the tracks files <pre>"periods": [{ "number": 1, "startFrameClock": 1545836408396, "endFrameClock": 1545839180356 }, ...],</pre>
homePlayers	JSON Array of player objects	The home players on the roster for the match <pre>"homePlayers": [{ "ssiId": "2ab50ef5-7aec-4f57-b52f-f12aee300337", "optaId": "171129", "optaUuid": "dkt9892ixwnz1bkmgileo71sl", "name": "D. Rico", "number": "21" }, ...],</pre>
awayPlayers	JSON Array of player objects	The away players on the roster for the match <pre>"awayPlayers": [{ "ssiId": "00aa3b30-12a8-4163-9fed-fe58dc3bce8c", "optaId": "151119",</pre>

		<pre> "optaUid": "269gnyszrb8ezl57m1ampsd1h", "name": "D. Yedlin", "number": "22" }, ...] </pre>
pitchLength	Float (metres)	Length of the pitch <pre> "pitchLength": 104.8512, </pre>
pitchWidth	Float (metres)	Width of the pitch <pre> "pitchWidth": 67.9704 </pre>

Example period Object

```

{
  "number": 2,
  "startFrameClock": 1545840084636,
  "endFrameClock": 1545842967556,
  "startFrameIdx": 70619,
  "endFrameIdx": 14520,
  "homeAttPositive": true
}

```

PL period Metadata Object

Field	Type	Description
number	Int	Period number, 1 for the first half, 2 for the second half, 3 and 4 for extra time halves, and 5 for penalties <pre> "number": 2, </pre>
startFrameClock	Int	Start timestamp of this period's frame, in milliseconds from UNIX epoch <pre> "startFrameClock": 1545840084636, </pre>

endFrameClock	Int	End timestamp of this period's frame, in milliseconds from UNIX epoch <code>"endFrameClock": 1545842967556</code>
startFrameIdx	Int	Start frame index of this period <code>"startFrameIdx": 70619</code>
endFrameIdx	Int	End frame index of this period <code>"endFrameIdx": 14520</code>
homeAttPositive	Bool	True if the home team is attacking in the positive direction along the x-axis <code>"homeAttPositive": true</code>

Example player Object

```
{
  "ssiId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
  "optaId": "171129",
  "optaUuid": "dkt9892ixwnz1bkmgileo71sl",
  "name": "D. Rico",
  "number": "21",
  "player": "GK"
},
```

PL player Metadata object

Field	Type	Description
ssild	String	Second Spectrum Inc, player ID <code>"ssiId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",</code>
optald	String	Opta player ID <code>"optaId": "171129",</code>

optaUuid	String	Opta perform player ID <code>"optaUuid": "dkt9892ixwnz1bkmgileo71sl",</code>
name	String	Full name of the player <code>"name": "Asmir Begovic",</code>
number	Int	Jersey number of the player <code>"number": 27,</code>
position	String	Player position for this game as specified by Opta <code>"position": "GK"</code>

Example Game Metadata in XML

```
<MetaData sVersion="1.0">
  <match dtDate="2018-12-26 07:00:08" fPitchXSizeMeters="104.85" fPitchYSizeMeters="67.97"
iFrameRateFps="25" iId="987778">
    <period iEndFrame="1545839180356" iId="1" iStartFrame="1545836408396"/>
    <period iEndFrame="1545842967556" iId="2" iStartFrame="1545840084636"/>
    <period iEndFrame="0" iId="3" iStartFrame="0"/>
    <period iEndFrame="0" iId="4" iStartFrame="0"/>
  </match>
</MetaData>
```

MetaData Node

Attributes	Type	Description
sVersion		XML version export format <code>sVersion="1.0"</code>
match	match node	

Match Node

Attributes	Type	Description
ild	String	Opta game ID
dtDate	String	Date and start time
fPitchXSizeMeters	Float (metres)	Length of the pitch in metres
fPitchYSizeMeters	Float (metres)	Width of the pitch in metres
iFrameRateFps	Int	Number of frames per second
period	period nodes	

Period Node

Attributes	Type	Description
ild	Int	Period number, 1 for the first half, 2 for the second half, 3 and 4 for extra time halves
iStartFrame	Int	Timestamp of the first frame of this period in milliseconds from UNIX epoch
iEndFrame	Int	Timestamp of the last frame of this period, in milliseconds from UNIX epoch

Shared Object Fields

Message objects for the all tracking output share some common field that are defined below:

Field	Type	Description
frameIdx	Int	Frame index. Frame indices start at 0 at the beginning of

		the match and increment until the end of the match <code>"frameIdx": 11254</code>
period	Int	Period number, 1 for the first half, 2 for the second half, 3 and 4 for extra time halves, and 5 for penalties <code>"period": 1</code>
gameClock	Float (seconds)	Time since the start of the period <code>"gameClock": 719.34</code>

Tracking Output

Overview

The tracking file consists of a sequence of TrackingMessages containing the coordinates for

- Up to 22 players (11 home, 11 away)
- The ball

for all frames of a match. Frame exports will include a timestamp, encoded as the number of milliseconds since January 1, 1970, GMT. The timestamp will be provided by Second Spectrum's system server, which is synced to external world time via NTP.

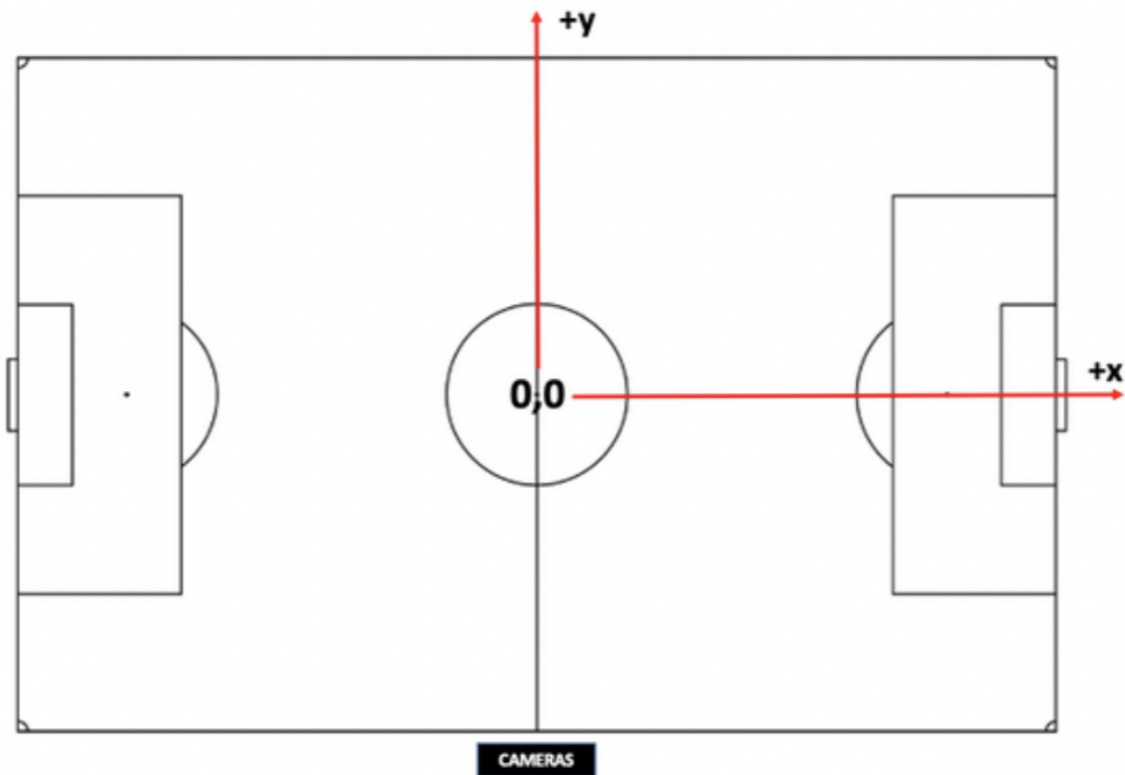
Note: Tracking file will be available in .jsonl and .xml format.

Coordinate System

The coordinate system used to represent locations matches legacy tracking systems. It is a right-handed coordinate system with

- the origin (0, 0, 0) at the center of the pitch
- X-axis running along the touch lines, positive to the right
- Y-axis running along the end lines, positive away from the viewer
- Z-axis is vertical, with positive values above the pitch

- units in metres



Object Definitions

Example TrackingMessage² in JSON Line

```
{
  "period": 1,
  "frameIdx": 988,
  "gameClock": 39.52,
  "wallClock": 1552761000000,
  "homePlayers": [
    {
      "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
      "optaId": "126184",
      "number": 10,
      "xyz": [48.77, 10.82, 0.0],
      "speed": 0.94,
```

² The example message is formatted for easy reading. Actual output messages will not contain linefeeds or extra whitespace.

```

    },
    {
      "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
      "optaId": "126184",
      "number": 18,
      "xyz": [16.09, 9.35, 0.0],
      "speed": 2.93
    },
    ...
  ],
  "awayPlayers": [
    {
      "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
      "optaId": "126184",
      "number": 6,
      "xyz": [15.8, 13.2, 0.0],
      "speed": 0.05
    },
    {
      "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337",
      "optaId": "126184",
      "number": 1,
      "xyz": [11.1, 6.15, 0.0],
      "speed": 5.35
    },
    ...
  ],
  "ball": {
    "xyz": [1.75, 0.7, 2.0],
    "speed": 12.85
  }
}

```

TrackingMessage Objects

Field	Type	Description
Shared fields from Overview		
homePlayers	JSON Array of Player	IDs and coordinates of home team players. Will have an item

	Location objects	<p>for each player on the pitch.</p> <pre> "homePlayers": [{ "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337", "optaId": "126184", "number": 10, "xyz": [48.77, 10.82, 0.0], "speed": 0.94 }, ...], </pre>
awayPlayers	JSON Array of Player Location objects	<p>IDs and coordinates of away team players. Will have an item for each player on the pitch.</p> <pre> "awayPlayers": [{ "playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337", "optaId": "126184", "number": 6, "xyz": [15.8, 13.2, 0.0], "speed": 0.05 }, ...], </pre>
ball	BallLocation object	<p>3D location and speed of the ball. If the ball is not visible in the tracking area, this will be null ("null").</p> <pre> "ball": { "xyz": [1.75, 0.7, 2.0], "speed": 12.85 } </pre>

PlayerLocation Objects

Field	Type	Description
playerId	String	2S ID <code>"playerId": "2ab50ef5-7aec-4f57-b52f-f12aee300337"</code>
optaId	String	Opta ID <code>"playerId": "121599"</code>
number	Int	Player jersey number <code>"number": 10</code>
xyz	JSON Array of 3 Floats (metres)	Location of the player. For players z (height) is always zero <code>"xyz": [17.16, 14.12, 0]</code>
speed	Float (metres/second)	Instantaneous speed of the player <code>"speed": 5.35</code>

BallLocation Objects

Field	Type	Description
xyz	JSON Array of 3 Floats (metres)	Location of the ball <code>"xyz": [1.75, 0.7, 2.0],</code>
speed	Float (metres/second)	Instantaneous speed of the ball <code>"speed": 12.85</code>

XML Tracks Sample³

```
<?xml version="1.0" ?>
<tracks>
  <period number="1">
    ...
    <frame live="False" possession="away" time="2881.68" wall_clock="1552761900000">
      <player dist="0.03" id="2ab50ef5-7aec-4f57-b52f-f12aee300337" loc="[19.26, -10.15,
0.0]" num="10" spd="0.63"/>
      <player dist="0.02" id="00aa3b30-12a8-4163-9fed-fe58dc3bce8c" loc="[-37.79, 5.23,
0.0]" num="19" spd="0.74"/>
      ...
      <ball dist="0.12" loc="[-4.54, 28.95, 0.01]" spd="6.26"/>
    </frame>
    ...
  </period>
  ...
</tracks>
```

Tracks Node

Attribute	Type	Description
period	period nodes	Depending on the number of periods, half number, or overtime period. Since PL games consist of two halves, overtime periods continue counting from 3.

Period Node

Attribute	Type	Description
number	Int	Period number, 1 for the first half, 2 for the second half, 3 and 4 for extra time halves, and 5 for penalties
frame	List of frame nodes	Unfixed number of frames in each period

³ The example message is formatted for easy reading. Actual output messages will not contain linefeeds or extra whitespace.

Frame Node

Attribute	Type	Description
live	Bool	Indicates if play is currently live
possession	String	Indicates the last team to touch the ball, either “home” or “away”
time	Float	Time since the start of the period in seconds
wall_clock	String	Time of the frame, encoded as the number of milliseconds since January 1, 1970, GMT
player	player nodes	One for each player on the pitch
ball	ball node	

Player Node

Attribute	Type	Description
dist	Float	Distance travelled by the player since the previous frame
id	String	Second Spectrum Player ID
loc	Array of Floats	Location of the player, [x, y, 0.0]
num	Int	Player jersey number
spd	Float	Instantaneous speed of the player in metres/second

nBall Node

Attribute	Type	Description
dis	Float	Distance travelled by the ball since the previous frame
loc	Bool	Location of the player, [x, y, z]

spd	Float	Instantaneous speed of the ball
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Tracking Signals

Additional signals can be sent with tracks to provide context during the match. Currently the only signal is sent at the end of each period through the tracking-produced feed.

Object Definitions

Example Signal⁴ in JSON Line

```
{
  "messageType": "periodEnd",
  "parameters":
    {
      "periodNumber":
    }
}
```

Signal Object

Attribute	Type	Description
messageType	String	The type of message is “periodEnd” signal.
parameters	parameters Object	Additional details for the message, the available parameters are determined by the messageType

periodEnd Parameters Object

Attribute	Type	Description
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⁴ The example message is formatted for easy reading. Actual output messages will not contain linefeeds or extra whitespace.

periodNumber	Int	Period number, 1 for the first half, 2 for the second half, 3 and 4 for extra time halves, and 5 for penalties
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