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# THE INTRODUCTION OF DIFFERENT TIME SERIES POSSIBILITIES (CURVETYPE) WITHIN ENTSO-E ELECTRONIC DOCUMENTS

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2022-02-01

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APPROVED DOCUMENT  
VERSION 1.4

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## Revision History

Version	Release	Date	Paragraph	Comments
0	0	2009/09/30		Document release
1	0	2009/11/20		Comments from EDI WG members. Document approved by ENTSO-E Market Committee on 2009/12/11.
1	1	2011/05/05		Precision on the use of gaps and typing errors corrections. Approved by Market Committee on 2011-05-17.
1	2	2019/03/28		Updates in chapters 2 and 3 to have into account the current ESMP CIM standards. Approved by MC.
1	3	2021/06/01		When the resolution is zero, as it could be for point values (format PT0S), the formula for how to calculate the maximum number of repetitions of the Point class will give an undefined result. Clarifications were added to the document. Approved by MC.
1	4	2022/02/01		Added a new statement explaining that all the new data exchanges shall use curve type. Approved by MC.

43

## 44 1 INTRODUCTION

45 In 2001, ETSO Task Force Electronic Data Interchange (EDI) identified a requirement to  
46 handle time series for electricity transactions. These transactions concerned exchange of  
47 energy/power blocks with a constant time interval. For each time interval, the quantity value  
48 in the class "Interval" of the time series was either:

- 49 • A constant power in MW on the time interval  $[t_0, t_1[$ <sup>1</sup>
- 50 • An energy value in MWh for the time interval  $[t_0, t_1[$

51 These are only examples and the quantity value is depending upon the business process  
52 requirements, energy, power, water flow, temperature, price, etc. The same applies also for  
53 the data type, e.g. integer value, real with a given number of decimal, etc.

54 Since this first definition, new business requirements have appeared requiring time series  
55 capable of handling:

- 56 • Variable time intervals;
- 57 • The transmission of unrelated information for points in time;
- 58 • Ramping;
- 59 • Variable sized blocks.

60 In order to satisfy these new business requirements and not to disrupt the current method of  
61 handling time series information a study was carried out which not only kept in mind the  
62 original philosophy of handling time series but also addressed the new requirements.

63 The results of the study concluded that the existing time series method could optimally  
64 answer all the identified cases with the simple addition of an attribute to identify to sort of  
65 curve that was being provided.

66 This document outlines how the addition of a type of curve can address the requirements  
67 initially requested.

68 ENTSO-E recommends having a constant resolution when different Period classes are  
69 provided within one time series.

70 This implementation ensures the compatibility with all the existing documents developed  
71 within ENTSO-E CIM EG, ENTSO-E WG-EDI and the former organisation ETSO TF EDI.

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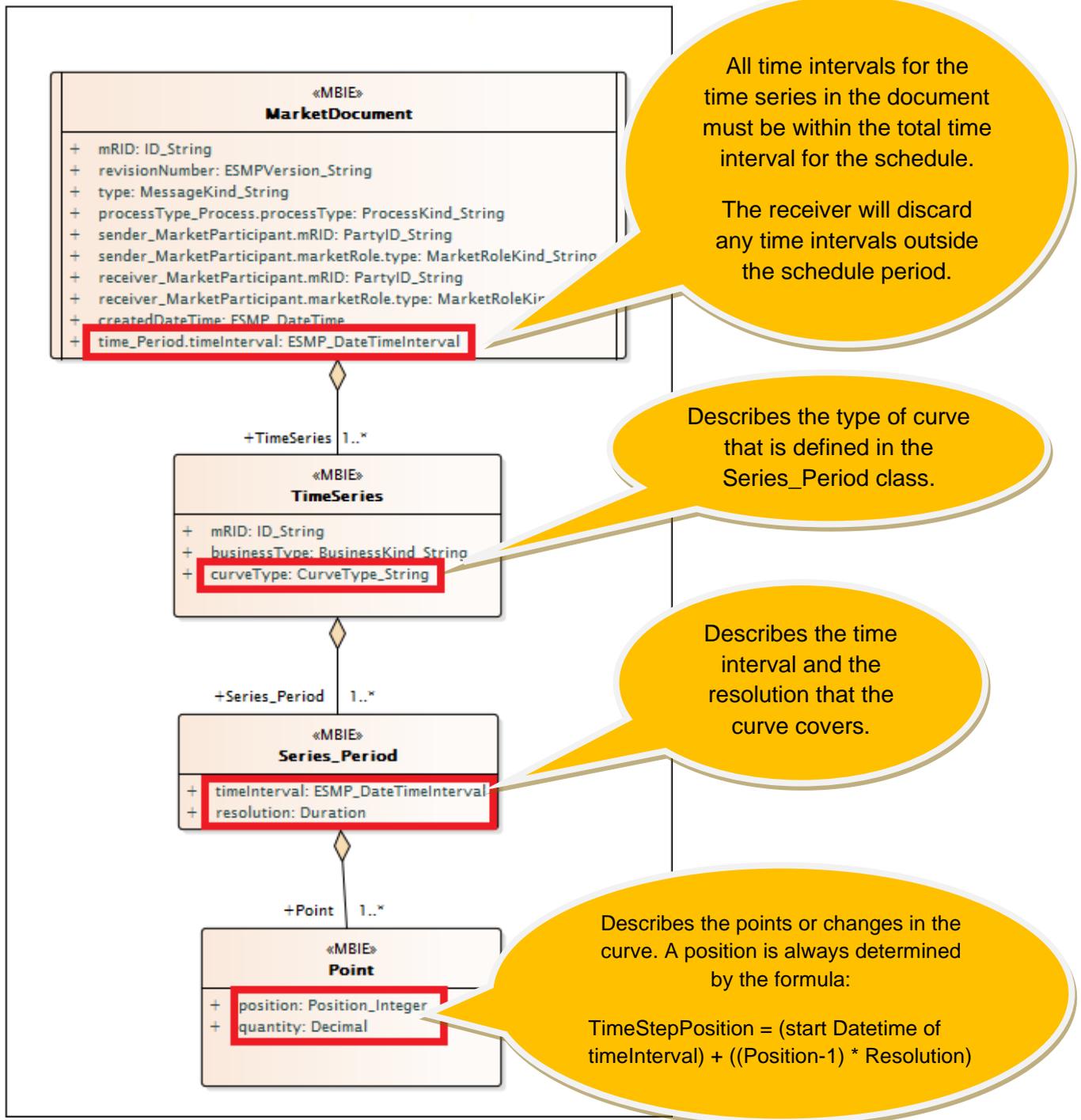
<sup>1</sup> Notation convention:

- $[t_0, t_1]$  means that the period is such that  $t_0 \leq t \leq t_1$
- $[t_0, t_1[$  means that the period is such that  $t_0 \leq t < t_1$
- $]t_0, t_1]$  means that the period is such that  $t_0 < t \leq t_1$
- $]t_0, t_1[$  means that the period is such that  $t_0 < t < t_1$

## 72 2 ENTSO-E TIME SERIES USE

73 ENTSO-E uses a standardised set of ESMP CIM (IEC 62325-351) classes to provide time  
74 series information. This layout takes basic form outlined in figure 1.

75



76

77

FIGURE 1: BASIC TIME SERIES LAYOUT

78 It's needed to associate a `timeInterval` attribute to the `MarketDocument` class to specify the  
79 total time interval covered by the document. All time intervals for the time series in the  
80 document must be within the total time interval associated to the `MarketDocument` class.

81 The `Time Series` class contains all the details describing what the time series represents.  
82 Amongst all the time series descriptive information there is an attribute called "`CurveType`".  
83 This attribute is used to describe the type of curve that is being provided for the `Time Series`  
84 in question.

85 If the "`CurveType`" attribute is omitted in the XML instance a default value of "sequential fixed  
86 size blocks" shall be understood. This ensures that compatibility is maintained with existing  
87 implementations. However in order to avoid implicit rules, all the new data exchanges and  
88 implementation guides shall use the `curveType` attribute.

89 The `Series_Period` class provides the information defining the time interval that is covered  
90 and the resolution of the time step within the `Period`.

91 The `Point` class provides all the content for a given time step which is identified by the  
92 attribute "`Position`". The attribute "`Position`" always begins at the value "1". The maximum  
93 number of repetitions of the `Point` class is determined assuming that all variables are  
94 expressed as an integer number of `Resolution` units by the formula:

$$95 \quad \frac{EndDateTime - StartDateTime}{Resolution}$$

96 However, the effective number of `Intervals` depends on the `CurveType` element contents.

97

98 Note: The formula above is only valid when the resolution is higher than 0. If the resolution is  
99 zero, only one repetition of the `Point` class is allowed.

### 100 3 CALCULATION OF THE POSITION OF AN INTERVAL IN TIME

101 The exact time position within a `Series_Period` class shall be calculated in the following  
102 manner:

$$103 \quad TimeStepPosition = StartDateTimeOfTimeInterval + (Resolution * (Pos - 1))$$

104 with `Pos` being the `Position` value of the `Point` class.

105 For example: if there was a `Time Interval` with 2009-01-01T22:00/2009-01-02T22:00 and a  
106 `Resolution` of PT30M, The `TimeStepPosition` for a `Pos` with the value of 9 would be 2009-01-  
107 02T02:00, i.e. the interval [02:00, 02:30[ for a sequential fixed size blocks "`CurveType`".

108 This formula is true in all cases of the use of the ENTSO-E `Time Series` principles.

109 It must be borne in mind that by convention the start date and time is included whereas the  
110 end date and time is excluded, i.e. [start date and time, end date and time[. For `CurveType`  
111 "A04" and `CurveType` "A05", the end date and time although excluded must be included to  
112 define the possible ramp. This will be defined within the detailed description of the time  
113 series.

114 The time is always represented as the horizontal axe of the curve whereas the vertical axe is  
115 represented by the quantity.

## 116 4 CURVETYPE

117 In all five different types of curve have been identified to date. These are:

118 1. **Sequential fixed size blocks (A01):** The curve is made of successive Intervals of  
119 time (Blocks) of constant duration (size), where the size of the Blocks is equal to the  
120 Resolution of the Period. The TimeStepPosition of each Interval is equal to:

$$121 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

122 with Pos being the Position attribute value of the Point class.

123 The number of Intervals of a Period must be equal to:  $\frac{\textit{EndDateTime} - \textit{StartDateTime}}{\textit{Resolution}}$

124 All Intervals to cover the TimeInterval of a Period must be present.

125 The value of the Qty remains constant within each Block.

126 The formula above is only valid when the resolution is higher than 0.

127 2. **Points (A02):** The curve is made of successive instants of time (Points). Each Point  
128 is determined as follows:

$$129 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

130 with Pos being the Position attribute value of the Point class.

131 All Points must be within the Period TimeInterval.

132 The Qty of each Interval corresponds only to the value at the *TimeStepPosition*.

133 Note: If the resolution is zero, only one repetition of the Point class is allowed.

134 3. **Variable sized Blocks (A03):** The curve is made of successive Intervals of time  
135 (Blocks) of variable duration (size), where the end date and end time of each Block  
136 are equal to the start date and start time of the next Interval. For the last Block the  
137 end date and end time of the last Interval would be equal to EndDate`Time` of  
138 TimeInterval. The TimeStepPosition of each Interval is equal to:

$$139 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

140 with Pos being the Position attribute value of the Point class.

141 All Intervals to cover the TimeInterval of a Period must be present.

142 The value of the Qty remains constant within each Block.

143 4. **Overlapping Breakpoints (A04):** The curve is made of successive Intervals of time  
144 of variable duration (size), where the end date and end time of each interval are equal  
145 to the start date and start time of the next Interval. The TimeStepPosition of each  
146 Interval is equal to:

$$147 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

148 with Pos being the Position attribute value of the Point class.

149 All Intervals to cover the TimeInterval of a Period must be present.

150 The value of the Qty at instant t evolves linearly with the time within a TimeInterval as  
151 follows:

$$152 \quad Qty(t) = \frac{Qty_{end} - Qty_{start}}{TimeStepPosition_{end} - TimeStepPosition_{start}} * (t - TimeStepPosition_{start}) + Qty_{start}$$

153 where the “start” and “end” index refers respectively to the current Position and to the  
154 next Position provided in the Timeseries. This formula is to be applied only for the  
155 time inside a given Period (the TimeStepPosition<sub>end</sub> and the TimeStepPosition<sub>start</sub>  
156 cannot be the same), overlapping breakpoints are identified by a change of period.

157 For the last interval, the TimeStepPosition<sub>end</sub> must be equal to the EndDateTime of  
158 TimeInterval.

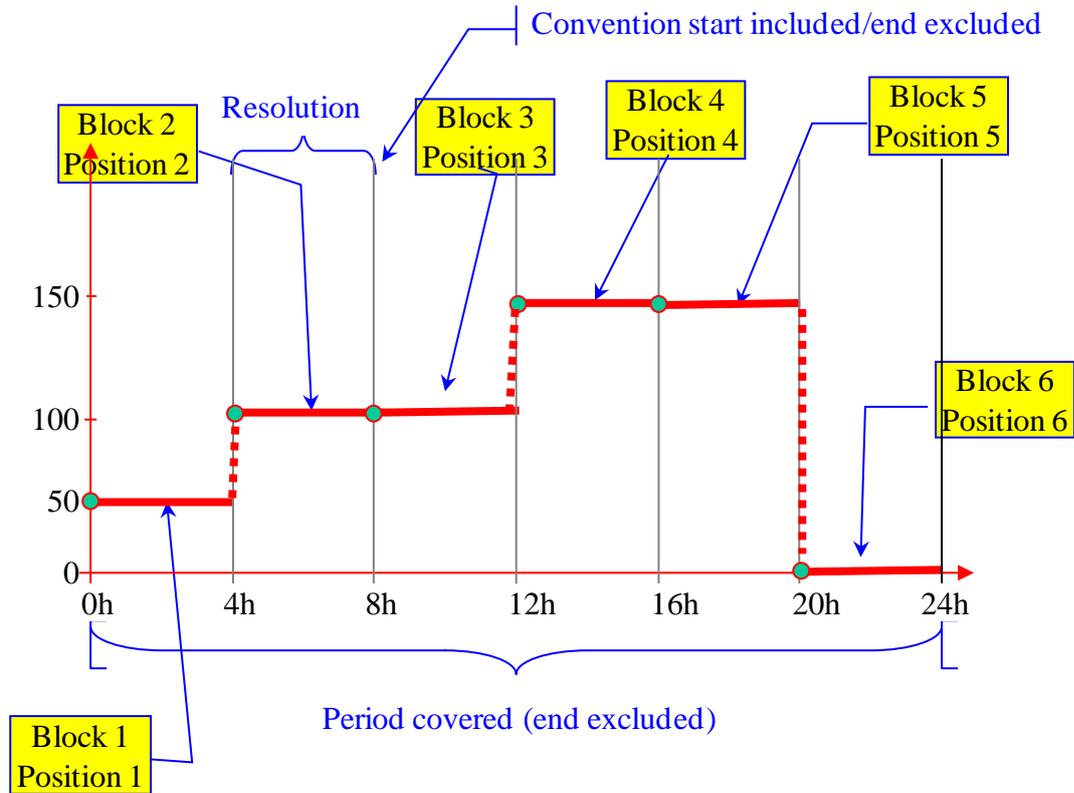
159 5. **Non-overlapping Breakpoints (A05):** This curve is a restriction of the previous one,  
160 i.e. overlapping breakpoints; the restriction is that a single Period is allowed. Thus,  
161 the TimeStepPosition<sub>end</sub> of a TimeInterval and the TimeStepPosition<sub>start</sub> of a  
162 TimeInterval cannot be the same. All the other conditions apply.

163 These are described in the following paragraphs.<sup>2</sup>

---

<sup>2</sup> The examples, hereafter enclosed, are for a UTC time period of one day 2009-09-09T00:00/2009-09-10T00:00Z, depending upon the local time to be considered, the expression of the day may vary with the time saving periods. Moreover, the time period may vary depending upon the business requirements (such as for intraday processes, etc.).

164 **4.1 A01 – SEQUENTIAL FIXED SIZE BLOCKS (DEFAULT)**



165

166

FIGURE 2: SEQUENTIAL FIXED SIZE BLOCKS

167 The CurveType A01 corresponds to a Period where all the interval positions are present  
168 within the TimeInterval. The resolution corresponds to the interval. Consequently the number

169 of intervals must be equal to  $\frac{EndDateTime - StartDateTime}{Resolution}$ .

170 This corresponds to the current use of the TimeSeries for the ENTSO-E ESS, ESP, ERRP  
171 and ECAN uses. It is consequently considered as the default value for the CurveType should  
172 the element not be present.

173 In the example shown in Figure 2, there is a 24 hour day with a 4 hour resolution.

174 Applying the formula for a TimeInterval 2009-09-09T00:00/2009-09-10T00:00Z

175 
$$TimeStepPosition = StartDateTimeofTimeInterval + (Resolution * (Pos - 1))$$

176 The following positions are obtained:

177  $1 = (2009-09-09T00:00 + ((1-1) * PT4H) = 00:00 + ((0) * 4)$

178  $2 = (2009-09-09T00:00 + ((2-1) * PT4H) = 00:00 + ((1) * 4)$

179  $3 = (2009-09-09T00:00 + ((3-1) * PT4H) = 00:00 + ((2) * 4)$

180  $4 = (2009-09-09T00:00 + ((4-1) * PT4H) = 00:00 + ((3) * 4)$

181  $5 = (2009-09-09T00:00 + ((5-1) * PT4H) = 00:00 + ((4) * 4)$

182  $6 = (2009-09-09T00:00 + ((6-1) * PT4H) = 00:00 + ((5) * 4)$

183 Consequently there are 6 intervals:

- 184 1) Covering the interval [0h00, 04h00[ for a constant block of 50MW;
- 185 2) Covering the interval [4h00, 08h00[ for a constant block of 100MW;
- 186 3) Covering the interval [08h00, 12h00[ for a constant block of 100MW;
- 187 4) Covering the interval [12h00, 16h00[ for a constant block of 150MW;
- 188 5) Covering the interval [16h00, 20h00[ for a constant block of 150MW;
- 189 6) Covering the interval [20h00, 24h00[ for a constant block of 0MW.

190 This induces the following rules:

- 191 ✓ Each position identifies the start of a block;
- 192 ✓ All positions must be provided, i.e. all intervals covering the TimeInterval of a Period  
193 shall be present;
- 194 ✓ The value of the Qty remains constant within each block;
- 195 ✓ The block is represented by the position on the horizontal axe and the quantity on the  
196 vertical axe;
- 197 ✓ This corresponds to the current time series method and shall be considered as the  
198 default value.

199 **4.2 A02 – POINT**

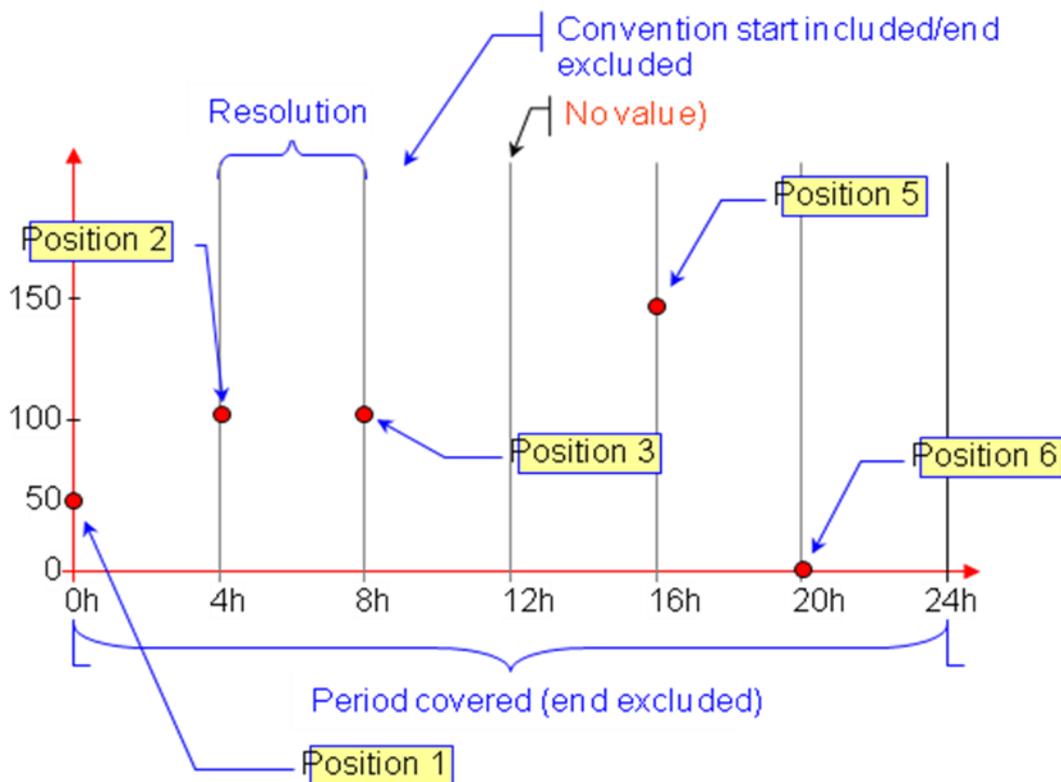


FIGURE 3: POINTS

200  
 201  
 202 The CurveType A02 corresponds to a Period where only the Interval positions that have data  
 203 are present within Time Interval. The resolution corresponds to the smallest expected interval  
 204 between two Points. In the case of meter readings it could be for example 1 hour. There is no  
 205 direct relation between 1 Point and the Next. Only the Interval position where the Point is  
 206 represented shall be provided. The number of Points possible is not directly defined, but  
 207 must be inferior to  $\frac{EndDateTime - StartDateTime}{Resolution}$ .

208 In the example in Figure 3, the smallest resolution has been defined as 4 hours. This  
 209 indicates that a reading is not expected in an interval less than 4 hours. The position  
 210 provides the exact time of the reading. In the example it can be seen that there are 5  
 211 readings corresponding to positions 1, 2, 3, 5 and 6.

212 Applying the formula for a TimeInterval 2009-09-09T00:00/2009-09-10T00:00Z

$$TimeStepPosition = StartDateTimeofTimeInterval + (Resolution * (Pos - 1))$$

214 The following positions are obtained:

215  $1 = (2009-09-09T00:00 + ((1-1) * PT4H) = 00:00 + ((0) * 4)$

216  $2 = (2009-09-09T00:00 + ((2-1) * PT4H) = 00:00 + ((1) * 4)$

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217  $3 = (2009-09-09T00:00 + ((3-1) * PT4H) = 00:00 + ((2) * 4)$

218  $5 = (2009-09-09T00:00 + ((5-1) * PT4H) = 00:00 + ((4) * 4)$

219  $6 = (2009-09-09T00:00 + ((6-1) * PT4H) = 00:00 + ((5) * 4)$

220 Consequently there are 5 interval elements that represent the time of the readings (a reading  
221 every 4 hours). The fourth reading is absent from the electronic document which signifies  
222 that no reading took place.

223 1) At 0h00- where the reading value was 50MW;

224 2) At 4h00 where the reading value was 100MW;

225 3) At 08h00 where the reading value was 100MW;

226 5) At 16h00 where the reading value was 150MW;

227 6) At 20h00 where the reading value was 0MW.

228 There is no relational significance between each reading other than the relation induced by  
229 the resolution This consequently induces the following rules:

230 ✓ Each position represents a point defined by the quantity on the vertical axe and the  
231 position time on the horizontal axe;

232 ✓ The quantity is the value at a given point in time, it is the business rules that have to  
233 define the meaning of this quantity;

234 ✓ Only points with a value are provided.

235

236 In the special case when only one point value is exchanged, it is allowed to specify the  
237 EndDateTime as the same as StartDateTime. There will then be only one repetition of the  
238 Point class.

239 Note: If the resolution is zero, also then only one repetition of the Point class is allowed.

240 **4.3 A03 – VARIABLE SIZED BLOCK**

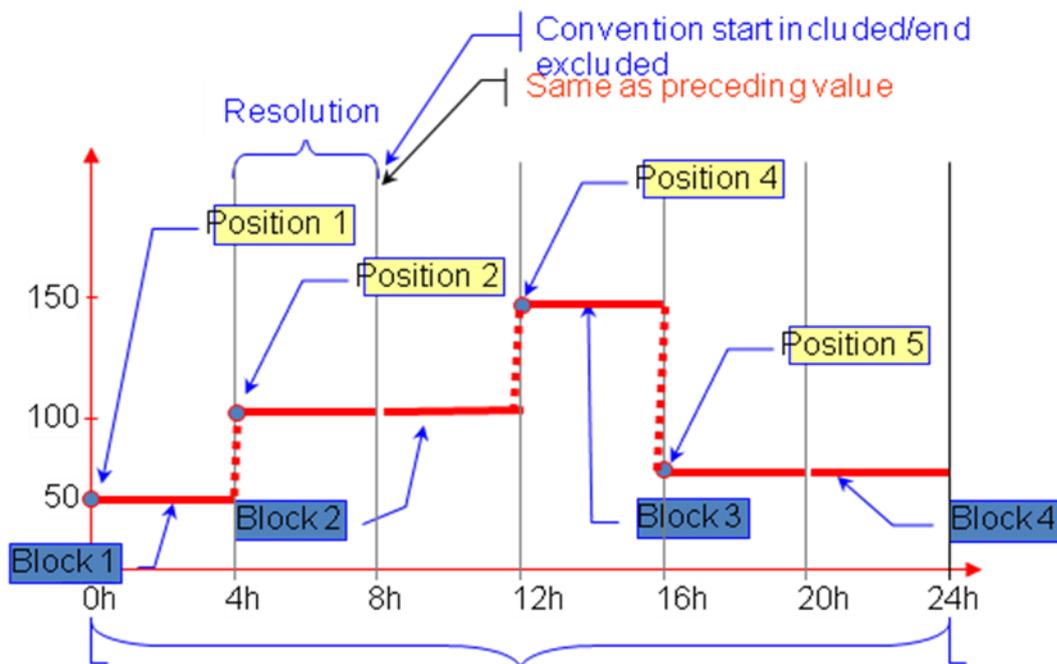


FIGURE 4: VARIABLE SIZED BLOCKS

241  
 242  
 243 The CurveType A03 differs from A01 in that only the position where a block change occurs is  
 244 provided. Consequently all positions are not provided. This is useful in cases where the  
 245 quantity is stable over a long period of time.

246 In the example in Figure 4, the first block begins at 00h00 for 50 megawatts. The second  
 247 block begins at 04h00 for 100 megawatts. This also implies that the first block terminates at  
 248 04h00. The third block begins at 12h00 for 150 megawatts. This also implies that the second  
 249 block terminates at 12h00. The fourth block begins at 16h00 for 50 megawatts and since  
 250 there is no other block presented it carries right through to the end of the day

251 Applying the formula for a TimeInterval 2009-09-09T00:00/2009-09-10T00:00Z

$$TimeStepPosition = StartDateTimeofTimeInterval + (Resolution * (Pos - 1))$$

252  
 253 The following positions are obtained:

254  $1 = (2009-09-09T00:00 + ((1-1) * PT4H) = 00:00 + ((0) * 4)$

255  $2 = (2009-09-09T00:00 + ((2-1) * PT4H) = 00:00 + ((1) * 4)$

256  $4 = (2009-09-09T00:00 + ((4-1) * PT4H) = 00:00 + ((3) * 4)$

257  $5 = (2009-09-09T00:00 + ((5-1) * PT4H) = 00:00 + ((4) * 4)$

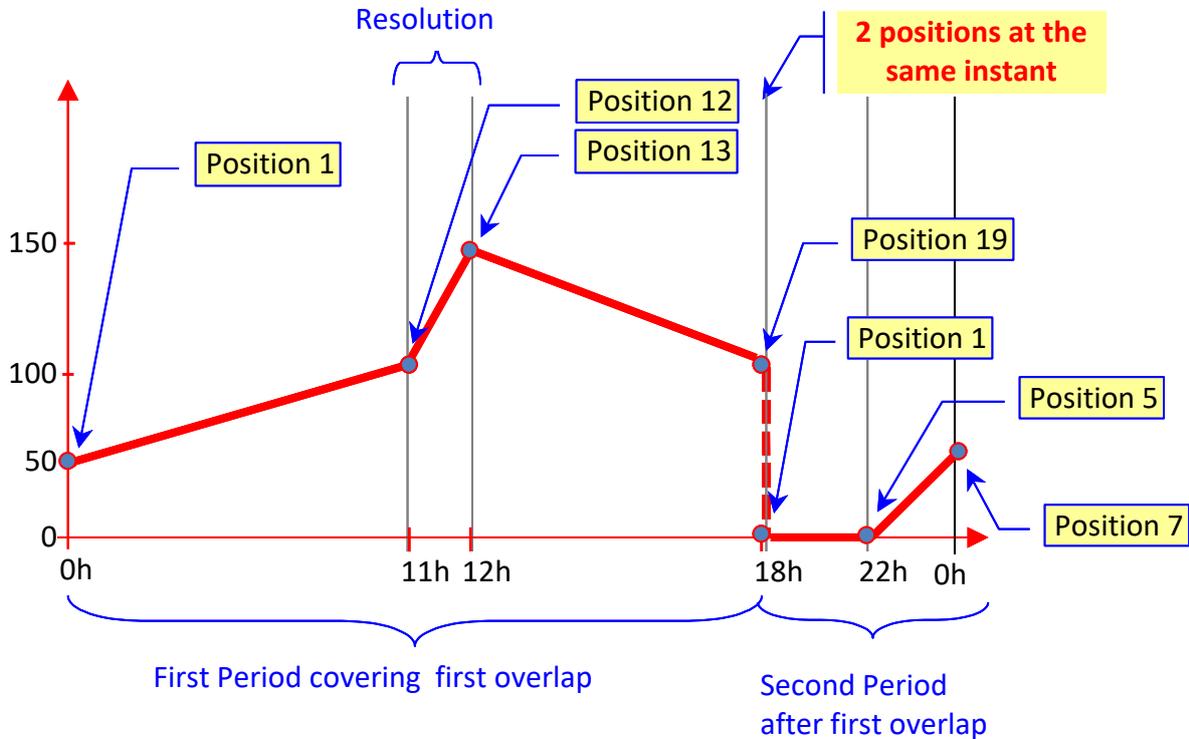
- 258 1) Covering the interval [0h00, 04h00[ with a value of 50MW;
- 259 2) Covering the interval [4h00, 12h00[ with a value of 100MW;
- 260 4) Covering the interval [12h00, 16h00[ with a value of 150MW;

261           5) Covering the interval [16h00, 24h00[ with a value of 50MW.

262    This induces the following rules:

- 263           ✓ Each position identifies the start of a block;
- 264           ✓ The end of the block is the start of the next block (except for the last one);
- 265           ✓ The last block extends to the end of the TimeInterval;
- 266           ✓ Only positions where a block change occurs are provided;
- 267           ✓ The value of the Qty remains constant within each block;
- 268           ✓ The block represents the start position on the horizontal axe and the quantity on the
- 269           vertical axe.

270 **4.4 A04 – OVERLAPPING BREAKPOINT**



271  
272

FIGURE 5: OVERLAPPING BREAKPOINTS

273 The CurveType A04 corresponds to the definition of breakpoints which differs from the  
274 CurveType A02, “Points”, insofar as there is a direct relation between a point, its predecessor  
275 and its successor.

276 Between one point and the next a straight line shall be drawn representing the evolution of  
277 the use of a quantity over time. The value of the Qty at instant t evolves linearly with the time  
278 within a TimeInterval as follows:

279 
$$Qty(t) = \frac{Qty_{end} - Qty_{start}}{TimeStepPosition_{end} - TimeStepPosition_{start}} * (t - TimeStepPosition_{start}) + Qty_{start}$$

280 where the “start” and “end” index refers respectively to the current Position and to the next  
281 Position provided in the Timeseries. This formula is to be applied only for the time inside a  
282 given Period (the TimeStepPosition<sub>end</sub> and the TimeStepPosition<sub>start</sub> cannot be the same),  
283 overlapping breakpoints are identified by a change of period.

284 Only the points where there is a change in ramp (breakpoint) are provided.

285 The resolution granularity should be equal to the smallest granularity expected.

286 In the example in Figure 5, the initial position of the period is at 00h00 for 50 megawatts. The  
287 resolution represents 1 hour. The first breakpoint occurs at 11h00 for 100 megawatts which

288 is represented by position 12. This signifies that there is a line drawn between the two points  
289 representing a slope going from 50 megawatts to 100 megawatts. There are no positions  
290 between the 1<sup>st</sup> position and the 12<sup>th</sup> position. The second breakpoint occurs at 12h00  
291 (position 13) with a change to 150 megawatts. The third breakpoint occurs at 18h00  
292 (occurrence of an overlap for this time, position 19 of the first Series\_Period class) with a  
293 change to 100 megawatts. There immediately follows at 18h00 (the second occurrence for  
294 this time, position 1 of the following Series\_Period class) a reduction down to 0 megawatts.  
295 The next breakpoint occurs at 22h00 (position 5 of the second Series\_Period class) with the  
296 start of an increase in quantity. The last breakpoint occurs at 24h00 (position 7 of the second  
297 Series\_Period class) where at the end of the period the quantity has moved to 50  
298 megawatts.

299 Applying the formula for the first TimeInterval 2009-09-09T00:00/2009-09-10T18:00Z and  
300 assuming a resolution of 1 hour.

$$301 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

302 The following positions are obtained:

$$303 \quad 1 = (2009-09-09T00:00 + ((1-1) * PT1H) = 00:00 + ((0) * 1)$$

$$304 \quad 12 = (2009-09-09T00:00 + ((12-1) * PT1H) = 00:00 + ((11) * 1)$$

$$305 \quad 13 = (2009-09-09T00:00 + ((13-1) * PT1H) = 00:00 + ((12) * 1)$$

$$306 \quad 19 = (2009-09-09T00:00 + ((19-1) * PT1H) = 00:00 + ((18) * 1)$$

307 1) At 0h00 the value is 50MW;

308 12) At 11h00 the value is 100MW (indicating that between 00:00 and 11:00 there is an  
309 increasing value going from 50 to 100MW);

310 13) At 12h00 the value is 150MW (indicating that between 11:00 and 12:00 there is an  
311 increasing value going from 100 to 150MW);

312 19) At 18h00 the value is 100MW (indicating that between 12:00 and 18:00 there is a  
313 decreasing value going from 150 to 100MW);

314 Applying the formula for the second TimeInterval 2009-09-09T18:00/2009-09-10T00:00Z and  
315 assuming a resolution of 1 hour.

$$316 \quad \textit{TimeStepPosition} = \textit{StartDateTimeofTimeInterval} + (\textit{Resolution} * (\textit{Pos} - 1))$$

317 The following positions are obtained:

$$318 \quad 1 = (2009-09-18T00:00 + ((1-1) * PT1H) = 18:00 + ((0) * 1)$$

$$319 \quad 5 = (2009-09-18T00:00 + ((5-1) * PT1H) = 18:00 + ((4) * 1)$$

$$320 \quad 7 = (2009-09-18T00:00 + ((7-1) * PT1H) = 18:00 + ((6) * 1)$$

321 1) At 18h00 the value is 0MW; the change of period indicates that there is an overlap  
322 and that the last value of the previous period provides indication on the ramp;

323 5) At 22h00 the value is 0MW (indicating that between 18h00 and 22:00 the value  
324 remained at 0MW);

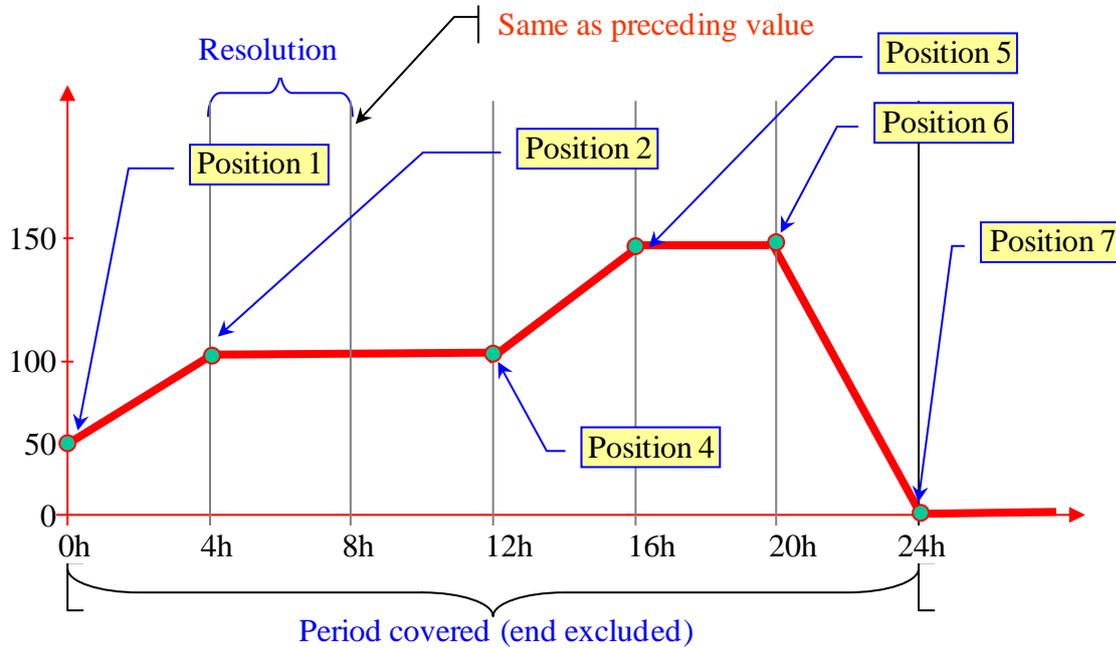
325 7) At 00h00 the value is 50MW (indicating that between 22:00 and 00:00 there is an  
326 increasing value going from 0 to 50MW);

327

328 This induces the following rules:

- 329 ✓ Each position identifies a breakpoint;
- 330 ✓ Each breakpoint is tied to the next breakpoint with a straight line;
- 331 ✓ Only positions where a breakpoint occurs are provided;
- 332 ✓ The breakpoint is represented by time on the horizontal axe and the quantity on the  
333 vertical axe;
- 334 ✓ When there are overlapping breakpoint, consecutive Series\_Period classes must be  
335 used and the end date and time of the first period must equal the start date and time  
336 of the following overlapping period;
- 337 ✓ For each TimeInterval, the position value of the EndDateTime shall be provided, i.e.  
338 the time interval includes the end date and time.

339 **4.5 A05 – NON-OVERLAPPING BREAKPOINT**



340  
 341

FIGURE 6: NON-OVERLAPPING BREAKPOINTS

342 The CurveType A05 corresponds to a Period where only the breakpoint positions are  
 343 present. Only the points representing a power value level change are present within Interval  
 344 for the Period. Each Breakpoint marks the end of the previous breakpoint. The resolution  
 345 corresponds to the smallest interval where a power level change may occur. This is a similar  
 346 curve type to the CurveType A04 except that overlapping breakpoints are not allowed.

347 The value of the Qty at instant t evolves linearly with the time as follows:

348 
$$Qty(t) = \frac{Qty_{end} - Qty_{start}}{TimeStepPosition_{end} - TimeStepPosition_{start}} * (t - TimeStepPosition_{start}) + Qty_{start}$$

349 where the “start” and “end” index refers respectively to the current Position and to the next  
 350 Position provided in the Timeseries. The TimeStepPosition<sub>end</sub> of a TimeInterval and the  
 351 TimeStepPosition<sub>start</sub> of a TimeInterval cannot be the same.

352 Applying the formula for a TimeInterval 2009-09-09T00:00/2009-09-10T00:00Z and  
 353 assuming a resolution of 4 hours.

354 
$$TimeStepPosition = StartDateTimeofTimeInterval + (Resolution * (Pos - 1))$$

355 The following positions are obtained:

356  $1 = (2009-09-09T00:00 + ((1-1) * PT4H) = 00:00 + ((0) * 4)$

357  $2 = (2009-09-09T00:00 + ((2-1) * PT4H) = 00:00 + ((1) * 4)$

358  $4 = (2009-09-09T00:00 + ((4-1) * PT4H) = 00:00 + ((3) * 4)$

359  $5 = (2009-09-09T00:00 + ((5-1) * PT4H) = 00:00 + ((4) * 4)$

360  $6 = (2009-09-09T00:00 + ((6-1) * PT4H) = 00:00 + ((5) * 4)$

361  $7 = (2009-09-09T00:00 + ((7-1) * PT4H) = 00:00 + ((6) * 4)$

362 1) At 0h00 the value is 50MW;

363 2) At 04h00 the value is 100MW (indicating that between 00:00 and 04:00 there is an  
364 increasing value going from 50 to 100MW);

365 4) At 12h00 the value is 100MW (indicating that between 04:00 and 12:00 the value is  
366 stable at 100MW);

367 5) At 16h00 the value is 150MW (indicating that between 12:00 and 16:00 there is an  
368 increasing value going from 100 to 150MW);

369 6) At 20h00 the value is 150MW (indicating that between 16h00 and 20:00 the value is  
370 stable at 150MW);

371 7) At 24h00 the value is 0MW (indicating that between 20h00 and 00:00 there is a  
372 decreasing value going from 150 to 0MW);

373 This induces the following rules:

374 ✓ Each position identifies a breakpoint;

375 ✓ Each breakpoint is related to the next with a straight line;

376 ✓ Only positions where a breakpoint occurs are provided;

377 ✓ The point is represented by time on the horizontal axe and the quantity on the vertical  
378 axe;

379 ✓ The position value of the EndDateTime shall be provided, i.e. the time interval  
380 includes the end date and time.

## 5 THE HANDLING OF GAPS

381  
 382 Gaps represent a period in time where no information of the time variable Qty is sent. The  
 383 exact meaning, in physical terms, of this lack of information depends upon the rules agreed  
 384 for the business process where the time variable is used. In particular it must not be  
 385 assumed, unless specifically agreed, that the lack of information is equivalent to assign the  
 386 value "zero" to the Qty element.

387 It can concern only certain CurveTypes, i.e. A03, A04 and A05.

388 Gap shall not be used with CurveType A01 in order to ensure compatibility with the previous  
 389 implementation.

390 When using CurveType A02, only the positions having values are provided, thus implicitly  
 391 gaps are managed.

392 A gap is represented by the presence of at least two disjoint Series\_Period classes within a  
 393 given time series, i.e. the end date and time of the first period is different from the start date  
 394 and time of the following period. The end date and time of the Period shall be considered as  
 395 the start date and time for the gap and the start date and time of the following Period shall be  
 396 considered as the end date and time for the gap.

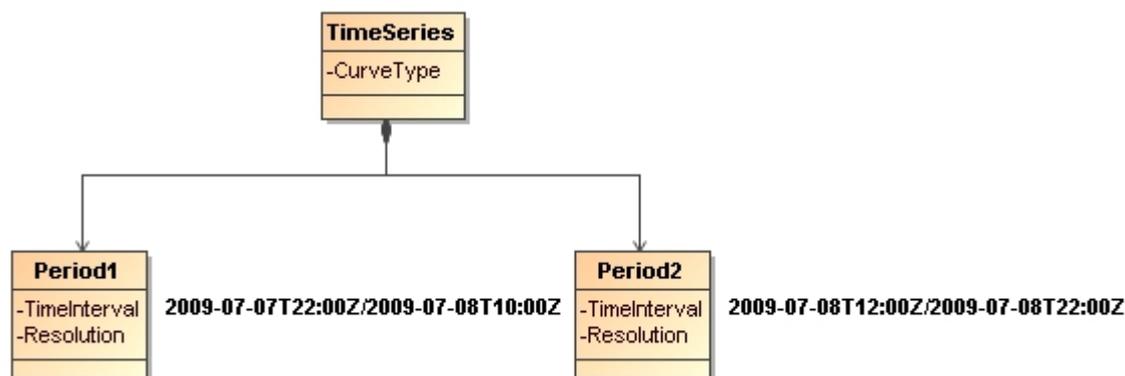
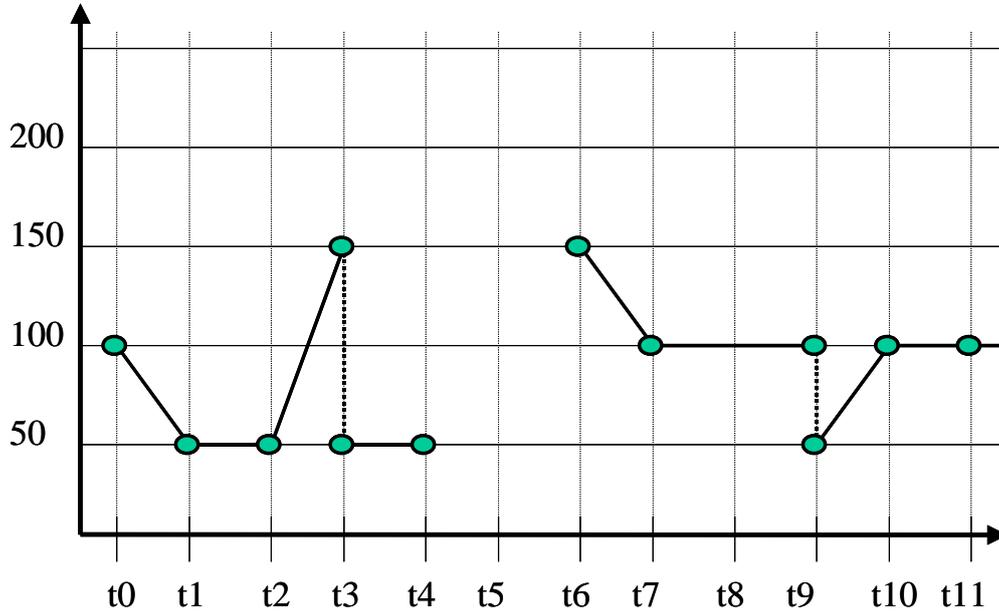


FIGURE 7: TIMESERIES GAP EXAMPLE

397  
 398  
 399 In the example in Figure 7, it can be seen that the first Period goes from 22h00 on the 7<sup>th</sup> of  
 400 July to 10h00 on the 8<sup>th</sup> of July. The second Period goes from 12h00 on the 8<sup>th</sup> of July to  
 401 22h00 on the 8<sup>th</sup> of July. Consequently it can be seen that the gap goes from 10h00 on the  
 402 8<sup>th</sup> of July to 12h00 on the 8<sup>th</sup> of July.

403 The gap itself therefore can be expressed as 2009-07-08T10:00Z/2009-07-08T12:00Z.  
 404 During the whole of this Period no information is being provided.

405 In addition, hereafter is included an example with gap and overlapping points using the  
 406 CurveType A04:



407  
 408

FIGURE 8: TIMESERIES GAP AND OVERLAP EXAMPLE

## TimeSerie with CurveType “A04”

- TimeInterval [t0, t3[
    - Pos 1: 100
    - Pos 2: 50
    - Pos 3: 50
    - Pos 4: 150
  - TimeInterval [t3, t4[
    - Pos 1: 50
    - Pos 2: 50
  - TimeInterval [t6, t9[
    - Pos 1: 150
    - Pos 2: 100
    - Pos 4: 100
  - TimeInterval [t9, t11+1[
    - Pos 1: 50
    - Pos 2: 100
    - Pos 3: 100
- Intervals with (end) = (start)  
thus overlap
- Intervals with (end) ≠ (start)  
thus gap
- Intervals with (end) = (start)  
thus overlap

409  
 410

FIGURE 9: TIMESERIES GAP AND OVERLAP DESCRIPTION