

A MusicXML Test Suite and a Discussion of Issues in MusicXML 2.0

Reinhold Kainhofer, reinhold@kainhofer.com

Vienna University of Technology, <http://www.fam.tuwien.ac.at/>
GNU LilyPond, <http://www.lilypond.org/>
Edition Kainhofer, Music publishing, <http://www.edition-kainhofer.com/>

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Overview

- 1 What is MusicXML?
 - MusicXML Specification by Recordare
- 2 A MusicXML 2.0 Test Suite
- 3 MusicXML 2.0: Semantic Ambiguities
- 4 Sub-Optimal XML Design
- 5 Missing Features
- 6 Issues in the conversion from MusicXML to LilyPond
- 7 Conclusion and Acknowledgements

What is MusicXML?

- **XML format** to represent **western-style music notation**
 - Musical content (Notes, chors, dynamics, time, key, clef, etc.)
 - Exact page layout (MusicXML 2.0)
 - Audio representation (like MIDI, not performance recording)
- Defined originally via **Document Type Definition (DTD)** files and later also via **XML Schema (XSD)** files.
- Defined by Recordare LLC, plugins for Finale, Sibelius, etc.
- Support (import and/or export) by many applications (notation, scanning, sequencers, etc.)

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An example: Schubert's Ave Maria (excerpt)

```
<?xml version="1.0"
  encoding="UTF-8"?>
<!DOCTYPE score-partwise
  PUBLIC [...] >
<score-partwise
  version="2.0">
  <work>
    <work-number>D.
      839</work-number>
    <work-title>Ave
      Maria</work-title>
  </work>
  <identification>
    <creator
      type="composer">F.
        Schubert</creator>
    <encoding>
      <software>Finale 2005 for
        Windows</software>
    </encoding>
  </identification>
  <defaults>
    [...]
    <music-font
      font-family="Maestro"
      font-size="18"/>
  </defaults>
  <part-list>
    <score-part id="P1">
      <part-name>Voice</part-name>
    </score-part>
    [...]
  </part-list>
  <!-- -->
```

```
<part id="P1">
  <measure number="1">
    <attributes>
      <divisions>48</divisions>
      <key>
        <fifths>-2</fifths>
        <mode>major</mode>
      </key>
      <time symbol="common">
        <beats>4</beats>
        <beat-type>4</beat-type>
      </time>
      <clef>
        <sign>G</sign>
        <line>2</line>
      </clef>
      <staff-details
        print-object="no"/>
    </attributes>
    <note>
      <rest/>
      <duration>192</duration>
      <voice>1</voice>
    </note>
  </measure>
  <!-- -->
  <measure number="2">
    <note>
      <rest/>
      <duration>192</duration>
      <voice>1</voice>
    </note>
  </measure>
  <!-- -->
```

```
<measure number="3" width="654">
  <print new-system="yes"/>
  <barline location="left">
    <bar-style>heavy-light</bar-style>
    <repeat direction="forward"/>
  </barline>
  <note default-x="122">
    <pitch>
      <step>B</step>
      <alter>-1</alter>
      <octave>4</octave>
    </pitch>
    <duration>72</duration>
    <voice>1</voice>
    <type>quarter</type>
    <dot/>
    <stem
      default-y="-55.5">down</stem>
    <lyric default-y="-82" number="1">
      <syllabic>begin</syllabic>
      <text>A</text>
    </lyric>
    <lyric default-y="-104"
      number="2">
      <syllabic>begin</syllabic>
      <text>A</text>
    </lyric>
    <lyric default-y="-127"
      number="3">
      <syllabic>begin</syllabic>
      <text>A</text>
    </lyric>
  </note>
  <note default-x="326">
```

Observations about MusicXML

- Extremely verbose! (e.g. first page of Ave Maria has 8768 lines / 250kB in XML)
- Score is structured into parts (here: vocal voice + Piano) \Rightarrow typically separate staves
- Each part structured into measures, each measure contains notes, rests, markup, etc.

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Advantages

- Standardized exchange format
- Support by many applications
- Good support

Problems

- Large size / verbosity
- Specification sometimes unclear / ambiguous
- No free reference implementation, no test cases

Overview

- 1 What is MusicXML?
- 2 A MusicXML 2.0 Test Suite
 - Why a Test Suite?
 - Structure of the Test Suite
 - Some Examples of Unit Tests
 - Sample Renderings of the Test Cases
 - Availability
- 3 MusicXML 2.0: Semantic Ambiguities
- 4 Sub-Optimal XML Design
- 5 Missing Features
- 6 Issues in the conversion from MusicXML to LilyPond
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Why a Test Suite

- No free reference implementation available (advice: Use the proprietary Dolet plugin for Finale)
- Only comments in the specification
- Only some complex sample files available at MusicXML homepage, showing off what MusicXML is able to do
- No set of basic unit test files available

Aim of this Unit Test Suite

- Full coverage including all possible elements and all combination not possible
- ⇒ Create representative test cases to catch as many common combinations as possible
- Small test cases, where a bug in one feature does not influence other cases
- Cover also some less used musical notation elements (but no cross-influences with other elements)

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Structure of the Test Suite

- 12 large feature categories (separate aspects of MusicXML, e.g. basic musical notation, staff attributes, note-related elements, page layout, etc.)
- Each category split into more specific aspects
- Each such aspect gets several different, non-overlapping test cases
- Structured by file name!
- More than 120 small unit test cases
- Current files: <http://www.kainhofer.com/musicxml/>

File naming scheme

AREAletter~AreaDescription-TestcaseDescription.xml

where *AREA* is a number between 00 and 99, identifying the large feature area, *letter* is a running letter to enumerate the test cases within a category, and the other file name parts are human understandable descriptions.

E.g. 01b-Pitches-Intervals.xml, 21e-Chords-PickupMeasures.xml, 46e-PickupMeasure-SecondVoiceStartsLater.xml

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Feature area categories

01-09 ... Basics

- 01 Pitches
- 02 Rests
- 03 Rhythm

10-19 ... Staff attributes

- 11 Time signatures
- 12 Clefs
- 13 Key signatures
- 14 Staff details

20-29 ... Note-related elements

- 21 Chorded notes
- 22 Note settings, heads, etc.
- 23 Triplets, Tuplets
- 24 Grace notes

30-39 ... Dynamics, artic., spanners

- 31 Dynamics and other single symbols
- 32 Notations and Articulations
- 33 Spanners

40-44 ... Parts

- 41 Multiple parts (staves)
- 42 Multiple voices per staff
- 43 One part on multiple staves

45-49 ... Measures and repeats

- 45 Repeats
- 46 Barlines, Measures

50-54 ... Page-related issues

- 51 Header information
- 52 Page layout

55-59 ... Exact positioning

60-69 ... Vocal music

- 61 Lyrics

70-75 ... Instrument-specific

- 71 Guitar notation
- 72 Transposing instruments
- 73 Percussion
- 74 Figured bass
- 75 Other instrumental notation

80-89 ... MIDI and sound

90-99 ... Other aspects

- 90 Compressed MusicXML files
- 99 Compat. with broken MusicXML

Testing multiple possible element uses vs. separation of separate item

Example: Parenthesized noteheads (<notehead parentheses=.../>)

- Parenthesized normal noteheads
- Parenthesized non-standard noteheads
- Parenthesized noteheads inside a chord
- Parenthesized chords (all noteheads)
- Parenthesized rests (default position)
- Parenthesized rests (explicit position)

The test case 22d-Parenthesized-Noteheads.xml for parenthesized noteheads tests all these cases in one file, but each of the settings on separate notes:



Example 1: Two tied notes (33b-Spanners-Tie.xml)

```
<?xml version="1.0" encoding="ISO-8859-1"
standalone="no"?>
<IDOTYPE score-partwise PUBLIC
" -//Recordare//DTD MusicXML 0.6b
Partwise//EN"
"http://www.musicxml.org/dtds/partwise.dtd">
<score-partwise>
<identification>
<miscellaneous>
<miscellaneous-field name="description">Two
simple tied whole
notes</miscellaneous-field>
</miscellaneous>
</identification>
<part-list>
<score-part id="P1"/>
</part-list>
<part id="P1">
<measure number="1">
<attributes>
<divisions>1</divisions>
<key>Xfifths>0</fifths></key>
<time>
<beats>4</beats>
<beat-type>4</beat-type>
</time>
<staves>1</staves>
<clef number="1">
<sign>G</sign>
<line>2</line>
</clef>
</attributes>
```

```
<note>
<pitch>
<step>F</step>
<octave>4</octave>
</pitch>
<duration>4</duration>
<tie type="start"/>
<voice>1</voice>
<type>whole</type>
<notations>Xtied type="start"/></notations>
</note>
</measure>
<measure number="2">
<note>
<pitch>
<step>F</step>
<octave>4</octave>
</pitch>
<duration>4</duration>
<tie type="stop"/>
<voice>1</voice>
<type>whole</type>
<notations>Xtied type="stop"/></notations>
</note>
</measure>
</part>
</score-partwise>
```



Example 2: Key signatures with microtones (33b-Spanners-Tie.xml)

[...]

```

<measure number="1">
  <attributes>
    <divisions>1</divisions>
    <key>
      <key-step>4</key-step>
      <key-alter>-1.5</key-alter>
      <key-step>6</key-step>
      <key-alter>-0.5</key-alter>
      <key-step>0</key-step>
      <key-alter>0</key-alter>
      <key-step>1</key-step>
      <key-alter>0.5</key-alter>
      <key-step>3</key-step>
      <key-alter>1.5</key-alter>
    </key>
    <time>
      <beats>2</beats>
      <beat-type>4</beat-type>
    </time>
    <clef>
      <sign>G</sign>
      <line>2</line>
    </clef>
  </attributes>
  <note>
    <pitch>

```

[...]



- Very exotic case!
- All possible alterations are checked!
- Observe bad XML design (see later!)

Connection to LilyPond

- Originally: Some test files for musicxml2ly (Converter from MusicXML to LilyPond; <http://www.lilypond.org/>)
- Still resides inside LilyPond source code repository
- Automated **sample renderings** can be done of MusicXML test case (No reference renderings!):
 - musicxml2ly is just one particular implementation with one particular interpretation of ambiguities!
 - musicxml2ly does not support every aspect perfectly
 - The MusicXML specification leaves many things open (⇒ left to each importing application!)
- Future plan: Include sample renderings from other applications, too. (Need to extend lilypond-book for this!)

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Sample Renderings of the Test Cases

[<< Test cases]
[To pICo nemeu[Index I ?]
[>>]
[< 12 ... Key signatures]
[Up : Test cases]
[21 ... Chorded notes >]

14 ... Staff attributes

[14-StaffAttributes-ly](#) The number of staff lines can be modified by using the staff-lines child of the staff-details attribute. This can happen globally (the first staff has one line globally) or during the part at the beginning of a measure and even inside a measure (the second part has 5 lines initially, 4 at the beginning of the second measure, and 3 starting in the middle of the third measure).

[<< Test cases]
[To pICo nemeu[Index I ?]
[>>]
[< 14 ... Staff attributes]
[Up : Test cases]
[22 ... Note settings heads etc. >]

21 ... Chorded notes

[21a-Chord-Basic-ly](#) One simple chord consisting of two notes.

[21b-Chord-Technique-ly](#) Some subsequent (identical) two-note chords.

[21c-Chord-ThreeNotesDuration-ly](#) Some three-note chords, with various durations.

[21d-Chord-Subsequent-RepeatMeter-ly](#) Chords in the second measure, after several ornaments in the first measure and a p at the beginning of the second measure.

[21e-Chord-PickupMeasure-ly](#) Check for proper chord detection after a pickup measure (i.e. the first beat of the measure is not aligned with multiples of the time signature)

[21f-Chord-Element-ly](#) Between the individual notes of a chord there can be direction or harmony elements, which should be properly assigned to the chord (or the position of the chord).

[<< Test cases]
[To pICo nemeu[Index I ?]
[>>]
[< 21 ... Chorded notes]
[Up : Test cases]
[22 ... Triplets/Tuplets >]

Availability and Download of the Test Suite

Availability of the Test Suite

- Web page: <http://kainhofer.com/musicxml/> (Download, sample renderings)
- Git repository: <http://git.sv.gnu.org/gitweb/?p=lilypond.git> (GNU)

License of the Test Suite

- MIT License (Basically BSD license): Can be used for any purpose, as long as the copyright notice (or LICENSE file) is left intact!

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 - Voice-Based
 - Attributes
 - Chords
 - Lyrics
 - Others
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Semantic Ambiguities

- MusicXML is a syntax definition
- Music notation is very complex, has many inherent semantic restrictions.
 - These cannot be properly expressed in a XML specification (via DTD or XSD)
 - Some MusicXML import plugins: Very strict about syntax, but happily accept non-sensical musical content
- MusicXML tries to provide features of different GUI applications!
- Many unclear issues in the spec; discussion (if anyone asks) on a mailinglist without public archives; no definitive documentation for future implementors

Semantic Ambiguities

- MusicXML is a syntax definition
- Music notation is very complex, has many inherent semantic restrictions.
 - These cannot be properly expressed in a XML specification (via DTD or XSD)
 - Some MusicXML import plugins: Very strict about syntax, but happily accept non-sensical musical content
- MusicXML tries to provide features of different GUI applications!
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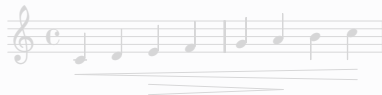
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a) MusicXML is a syntax definition, no semantic

- Music has many semantic restrictions for the contents to make sense
- Cannot be expressed in restrictions to the DTD / XSD

Examples of additional semantic restrictions

- Spanners in MusicXML (e.g. slurs `<slur number="1" type="start"/>` ... `<slur number="1" type="stop"/>`) can be arbitrarily overlapping
- Impossible to specify that each spanner must be closed properly
- Crescendo / Decrescendo cannot be overlapping in the same voice



- Can overlap for different voices (e.g. Flute 1 & 2 shown in one staff)



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b) Voice-Basedness of MusicXML

- MusicXML allows different voices on a staff, but does not enforce concept of voices (many notes at the same time allowed)
- MusicXML provides `<voice>1</voice>` element to specify belonging to a particular voice
- No clear definition what a voice in MusicXML means!
- `<voice>` is OPTIONAL, many applications leave it out
 - Side-question: What does a missing `<voice>` mean? voice 1? different from voice 1?
 - It is up to the importing application!
 - Each application will handle it differently
 - Advantage of a proper specification lost
- ⇒ No information which notes belong to together to form a melody line

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Importing applications will need to split up the notes in a part according to their needs \Rightarrow Even if `<voice>` given, it might not be used (overlapping notes...)



(From: Piano reduction of Mahler's 8. Symphony)

Which notes belong together? Good luck, if you don't have any voice attributes in the MusicXML file!

c) Staff and Measure Attributes

- Key, Clef, Time signature, etc. given in <attributes> blocks for a part
- What does presence of <attributes> indicate? The visual display?
- Some applications create <attributes> block for every measure, others only when a change happens
 - Case 1: Presence indicates display – breaks for apps writing attributes for every measure
 - Case 2: Presence does not force display – up to each application, imported MusicXML file might look different; No way to force a “cautionary” clef or key change!

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d) Chords in MusicXML

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<note>
  <pitch>
    <step>F</step>
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  </pitch>
  <duration>960</duration>
  <voice>1</voice>
  <type>quarter</type>
</note>
<note>
  <chord/>
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</note>
<note>
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- Chords are subsequent notes, 2nd has <chord/> element
 - Note with <chord/> must be after a note without <chord/>!
 - Can NOT be expressed (easily) in a DTD!
 - Introduced in PVG profile of Open Score Format (OSF) in XSD
- <forward.../> or <backward.../> elements before chorded note are allowed in spec... ⇒ Nonsense!
- What does it mean if different notes of a chord belong to different voices? How shall notation programs handle that?

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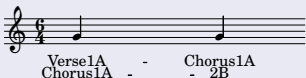
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e) Lyrics in MusicXML

```
<note>
  <pitch>
    <step>G</step>
    <octave>4</octave>
  </pitch>
  <duration>1</duration>
  <voice>1</voice>
  <type>quarter</type>
  <lyric number="1" name="Verse">
    <syllabic>begin</syllabic>
    <text>Verse1A</text>
  </lyric>
  <lyric number="1" name="Chorus">
    <syllabic>begin</syllabic>
    <text>Chorus1A</text>
  </lyric>
  <lyric number="1" name="Chorus">
    <syllabic>begin</syllabic>
    <text>AnotherChorus1A</text>
  </lyric>
  <lyric number="2" name="Chorus">
    <syllabic>begin</syllabic>
    <text>Chorus1A</text>
  </lyric>
</note>
</note>
```



- Lyrics in MusicXML are `<lyric>` sub-elements of `<note>`
- Different stanzas can be identified by number and name attribute!
- No clear definition how to determine which syllables belong together (if no name or number or both are given)
 - Up to importing applications
- Vertical position of syllables is more important than values of name or number elements ⇒ Separation of musical content and visual display broken!

f) Figured Bass, Harp Pedals etc.

```
<figured-bass parentheses="yes">
  <figure><figure-number>3</figure-number></figure>
  <duration>4</duration>
</figured-bass>
<note>
  <pitch><step>G</step><octave>4</octave></pitch>
  <duration>4</duration>
  <voice>1</voice>
  <type>eighth</type>
</note>
<figured-bass>
  <figure><prefix>flat</prefix><figure-number>3</figure-number></figure>
  <figure><prefix>natural</prefix><figure-number>5</figure-number></figure>
  <duration>6</duration>
</figured-bass>
<note>
  <pitch><step>G</step><octave>4</octave></pitch>
  <duration>6</duration>
  <voice>1</voice>
  <type>eighth</type>
  <dot/>
</note>
</measure>
```



- Bass figures are always assigned to "first regular note that follows"
 - In XML order? i.e. if `<backward.../>` follows before next note \Rightarrow different time
 - In time order? Hard to determine the next following note!
 - Problem is that restriction (`<note>` has to follow immediately) is not mentioned / defined in specification!!!
- slash of the `<suffix>` child element does not distinguish forward/backward slashes (same meaning, different display, up to importing applications)

f) Figured Bass, Harp Pedals etc.

```

<harp-pedals>
  <pedal-tuning>
    <pedal-step>D</pedal-step>
    <pedal-alter>0</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>C</pedal-step>
    <pedal-alter>-1</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>B</pedal-step>
    <pedal-alter>-1</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>E</pedal-step>
    <pedal-alter>0</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>F</pedal-step>
    <pedal-alter>0</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>G</pedal-step>
    <pedal-alter>1</pedal-alter>
  </pedal-tuning>
  <pedal-tuning>
    <pedal-step>A</pedal-step>
    <pedal-alter>-1</pedal-alter>
  </pedal-tuning>
</harp-pedals>

```



- Harp pedals: pedal states recommended in order D, C, B, E, F, G and A pedal.
- What if different order is used in MusicXML? Shall XML order be used or always the default order?
- No way to customize where the vertical separator will be displayed.

Overview

- 1 What is MusicXML?
- 2 A MusicXML 2.0 Test Suite
- 3 MusicXML 2.0: Semantic Ambiguities
- 4 Sub-Optimal XML Design**
 - Strict Element-Order
 - XML Element Naming
 - Metronome Markings
 - Enumerated Data Types
- 5 Missing Features
- 6 Issues in the conversion from MusicXML to LilyPond
- 7 Conclusion and Acknowledgements

Sub-Optimal XML Design Issues

- Not everything in the MusicXML specification is consistent!
- Backward compatibility in future versions \Rightarrow Can not be changed any more

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DTD definition of the <note> element

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    (cue, %full-note;, duration) |
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- Forces a fixed order of the children!
- Counter-intuitive order: duration (time length), then voice, then type (visual display)!
- Historically: Need restriction that some elements can only be there once
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Which of the following snippets is correct?

```
<note>
  <pitch>
    <step>G</step>
    <alter>1</alter>
    <octave>2</octave>
  </pitch>
  <accidental>sharp</accidental>
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  <type>quarter</type>
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b) Element Naming for Pitch Information

Normal note pitch

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    <octave>2</octave>
  </pitch>
  <duration>1</duration>
  <accidental>flat</accidental>
</note>
```

Root pitch of chord

```
<harmony>
  <root>
    <root-step>E</root-step>
    <root-alter>-1</root-alter>
  </root>
  <kind>major</kind>
</harmony>
```

Tuning of Tab staves

```
<attributes>
  <staff-details>
    <staff-lines>6</staff-lines>
    <staff-tuning line="1">
      <tuning-step>E</tuning-step>
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- All provide alteration / octave information for containing element!
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    <step>E</step>
    <alter>-1</alter>
    <octave>2</octave>
  </pitch>
  <duration>1</duration>
  <accidental>flat</accidental>
</note>
```

Root pitch of chord

```
<harmony>
  <root>
    <root-step>E</root-step>
    <root-alter>-1</root-alter>
  </root>
  <kind>major</kind>
</harmony>
```

Tuning of Tab staves

```
<attributes>
  <staff-details>
    <staff-lines>6</staff-lines>
    <staff-tuning line="1">
      <tuning-step>E</tuning-step>
      <tuning-alter>-1</tuning-alter>
      <tuning-octave>3</tuning-octave>
    </staff-tuning>
  <...>
</staff-details>
</attributes>
```

- All provide alteration / octave information for containing element!
- Why not use the same element and take context into account?

Normal note pitch

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b) Element Naming for Pitch Information

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c) Metronome Markings and Non-Standard Key Signatures

Contrast the over-correctness for `<*-step>` and `<*-alter>` (ignoring context, new name for basically same functionality) to Metronome marks and Non-Standard Key Signature definitions:

DTD for Metronome marks

```
<!ELEMENT metronome (
  beat-unit, beat-unit-dot*,
  ( ... |
    (beat-unit, beat-unit-dot*) )
)>
```

```
<metronome>
  <beat-unit>quarter</beat-unit>
  <beat-unit-dot/>
  <beat-unit-dot/>
  <beat-unit>half</beat-unit>
  <beat-unit-dot/>
</metronome>
```

- Tempo changes "old value = new value"
- Optional dots
- second unit can not be obtained directly!

DTD for Non-std. keys

```
<!ELEMENT key (
  (cancel?, fifths, mode?) |
  ((key-step, key-alter)* ) ,
  key-octave*
)>
```

```
<key>
  <key-step>0</key-step>
  <key-alter>-2</key-alter>
  <key-step>4</key-step>
  <key-alter>2</key-alter>
  <key-octave
    number="1">2</key-octave>
  <key-octave
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```

- Used to define accidentals for non-standard key signatures
- Step and alteration alternate
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d) Data Types in DTD / XSD (Enumerations and Integers)

- **DTD**: Mostly **#PCDATA** for all attributes
 - Possible values for enumerations described in comments
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 - Meaning/Handling of other values undefined
- **XSD**: **Enumerations**
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- 1 What is MusicXML?
- 2 A MusicXML 2.0 Test Suite
- 3 MusicXML 2.0: Semantic Ambiguities
- 4 Sub-Optimal XML Design
- 5 Missing Features**
 - Credit Elements: Header markup and purpose of credits
 - System separators and cadenzas
- 6 Issues in the conversion from MusicXML to LilyPond
- 7 Conclusion and Acknowledgements

Missing Features in MusicXML: Headers and Credit elements

- Document-wide headers/footers
 - `<credit page="..">` only allows page number (1 by default, `xsd:positiveInteger` in XSD)
 - Document-wide headers the same for all / all even / all odd pages
 - Suggestion: Allow "all", "even" and "odd" for the page attribute:

Suggestion for document-wide headers / footers

```
<credit page="even">
  <credit-words default-x="955"
    default-y="20">Even
    footer</credit-words>
</credit>
```

- Purpose of credit elements
 - All header, title, author labels are credit elements
 - credit stores only position on page, but not what information it displays
 - Impossible to extract metadata information about page layout (e.g. the arranger is placed on the upper left of the score)
 - Suggestion: Add an enumerated type attribute to `<credit>` element

Suggestion for information about credit element

```
<credit type="title">
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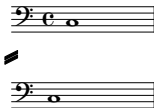
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Missing Features: System separators and Cadenzas

- System separator

- Systems in full scores separates by two slashes, currently not possible in MusicXML



Suggestion for system delimiter (in global defaults)

```
<defaults>
  <system-layout>
    <system-separator>double-slash</system-separator>
  </system-layout>
</defaults>
```

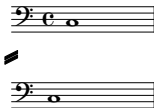
- Cadenzas

- No way to properly encode a cadenza and detect it as a cadenza
- A measure can have arbitrary number of beats (irrespective of time signature!)
- No way to mark the beginning of the cadenza
- No way to distinguish a real cadenza from an incorrect measure
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- 5 Missing Features
- 6 Issues in the conversion from MusicXML to LilyPond**
 - Staff-Assigned Items
 - Voice-Based vs. Measure-Based
 - Page Layout and Metadata
 - Musical Content vs. Graphical Representation
 - Workarounds in Some GUI Applications
- 7 Conclusion and Acknowledgements

Staff-Assigned Items

- MusicXML: "Directions" like dynamics assigned to staff position or note
- LilyPond: Everything assigned to note (possibly invisible spacer note "s")

⇒ All staff-assigned items need to be assigned to appropriate note in LilyPond

- Which note? The nearest note? What if there is no near note?
- Horizontal offsets to/from the note?

Special case: Staves with multiple voices/instruments



- First "p" applies to both voices (two notes present)
- "f" only to first voice (only first voice present)
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To generate instrumental parts, you want the dynamics assigned to correct voice (in many cases to both voices!)

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Measure Length: Voice-Based vs. Measure-Based

Different handling of measure lengths

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- LilyPond: **Music expressions** for each voice separately; only (optional) bar line checks, but no explicit concept of measures; Bar can only contain beats according to time signature

In LilyPond, voices are independently split into measures according to time signature, later voices are synchronized. ⇒ each voice must have **same number of beats!**

Overlapping notes (with or without explicit voice)

- MusicXML: Several **notes can overlap**, whether they belong to different voices or to the same
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⇒ Need to split up overlapping notes into different voices in LilyPond (hard to get right!)

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Page Layout and Metadata

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To produce the same layout as MusicXML: need to **extract metadata information from the <credit> elements** – **Not Possible!!!**

Different coordinate systems

MusicXML places headers and other credit markup at absolute coordinates on page, not possible in lilypond (only relative coordinates!)

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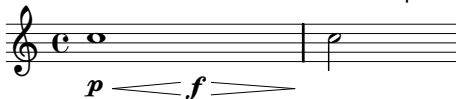
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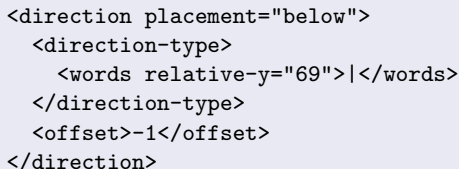
Musical Content vs. Graphical Representation

- LilyPond is a WYSIWYM application: You enter the music content, it formats it according to best-practices from centuries of music engraving (can be tweaked).
- MusicXML also mostly describes the musical content; adds layout information in extra sub-elements and attributes
- Some elements are tied to a horizontal position on the staff, e.g. dynamics:



- The position of the "f" in the music context can only be deduced from the graphical layout!

Chant example provided by Recordare as MusicXML sample file



- Divisio minima (short tick through the top-most staffline) faked by "`|`" text markup, appropriately shifted!!!!
- Can never be correctly imported!

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Conclusion

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Homepage of the test suite

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- Sample renderings available (created via `musicxml2ly` and LilyPond)
- MusicXML is a good industry standard for music notation exchange
- Several minor issues; discussed here for future implementors to know some problems / pitfalls
- Future versions of MusicXML will probably solve many of the mentioned problems

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