xMCF <femdata> and FatXML schema
A Proposal

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Description of Target:

Wish:

- Need to associate connections with their finite elements (FE)
  - This is what <femdata> is intended for.

Opportunity / Commonality:

- FatXML associates elements with CAD Parts.
  - Don’t want to re-invent the wheel
  - If <xmcf> is to be an element of FatXML, it should follow the same format or convention.

Target:

- Use common definition with FatXML.
  - AK27 controls this format, so xMCF inherits updates when needed.

What I tried:

<femdata> contains <CAE_DATA> element.

<CAE_DATA> definition in xMCF 3.0 appeared to be the same <CAE_DATA> of FatXML's.

Options:

- We **copy** the corresponding part of the schema.
- We **reuse** the corresponding part of the schema

- Copy:
  - definitions may diverge in the future.
  - advancements by one AK group will not be reflected to the other AK group.
- Reuse:
  - We asked AK27 to **extract-out** the CAE_DATA type.

Issues with reuse of <CAE_DATA>:

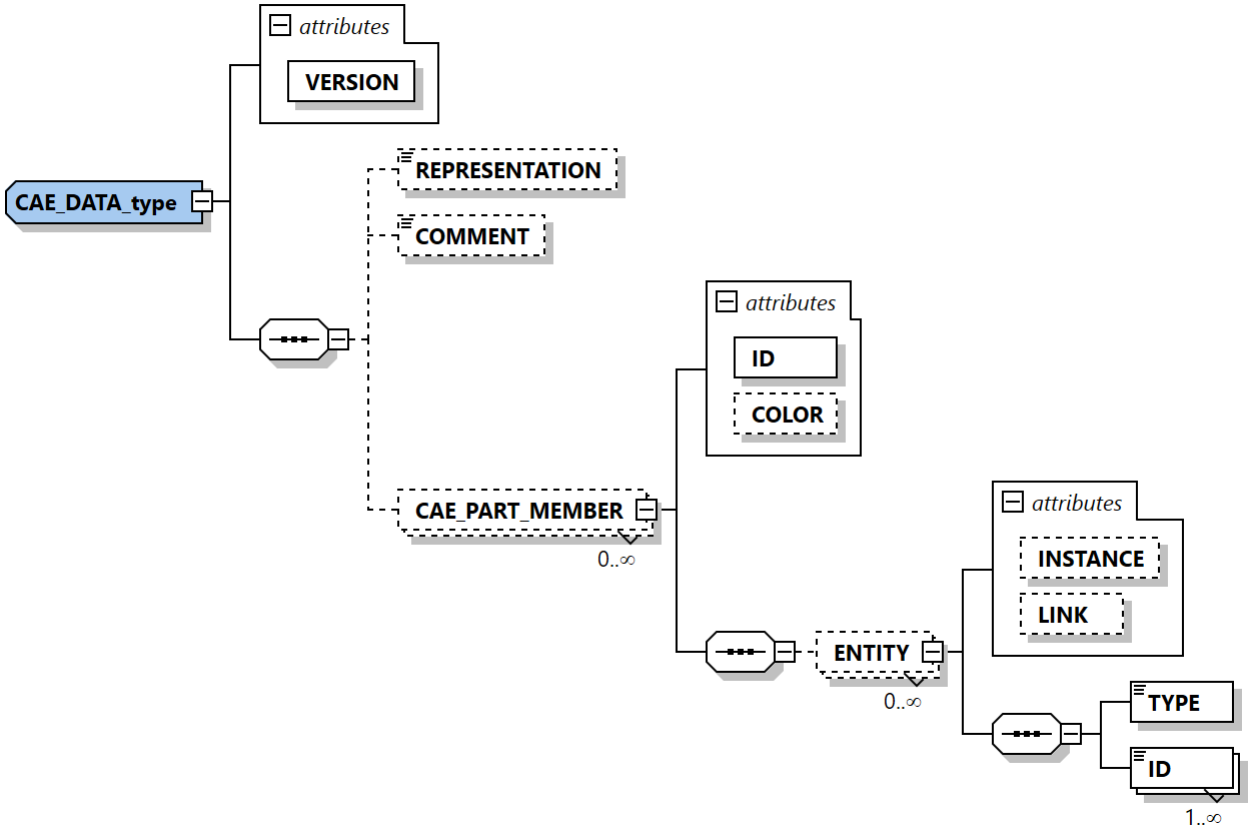
A common CAE_DATA type (<CAE_DATA_type>) is not a trivial issue.

- AK27 must have in their minds how CAE_DATA is used under the context of xMCF when they need to make changes to it.
  - They can't make changes to accommodate their change of requirements.

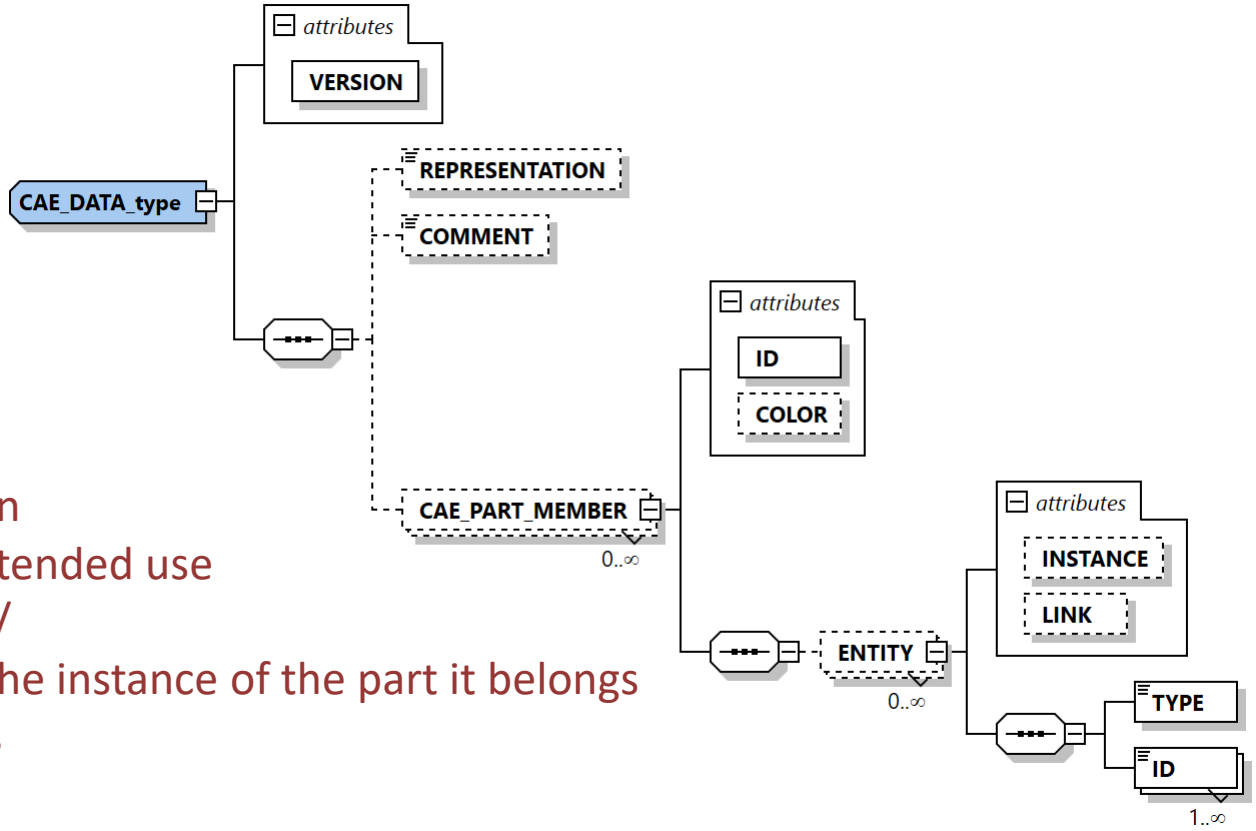
- CAE_DATA must always contain data equally useful for both formats.
- CAE_DATA content must mean the same thing under both contexts (Part Hierarchy and Connection Information).

- A common CAE_DATA type must have one reason to change.
  - The same reason for both formats.

Issues with reuse of <CAE_DATA>:



Issues with reuse of <CAE_DATA>:



Parts:

VERSION: part version

REPRESENTATION: intended use
NVH/Crash/

INSTANCE: refers to the instance of the part it belongs

LINK: faces have links

Connections:

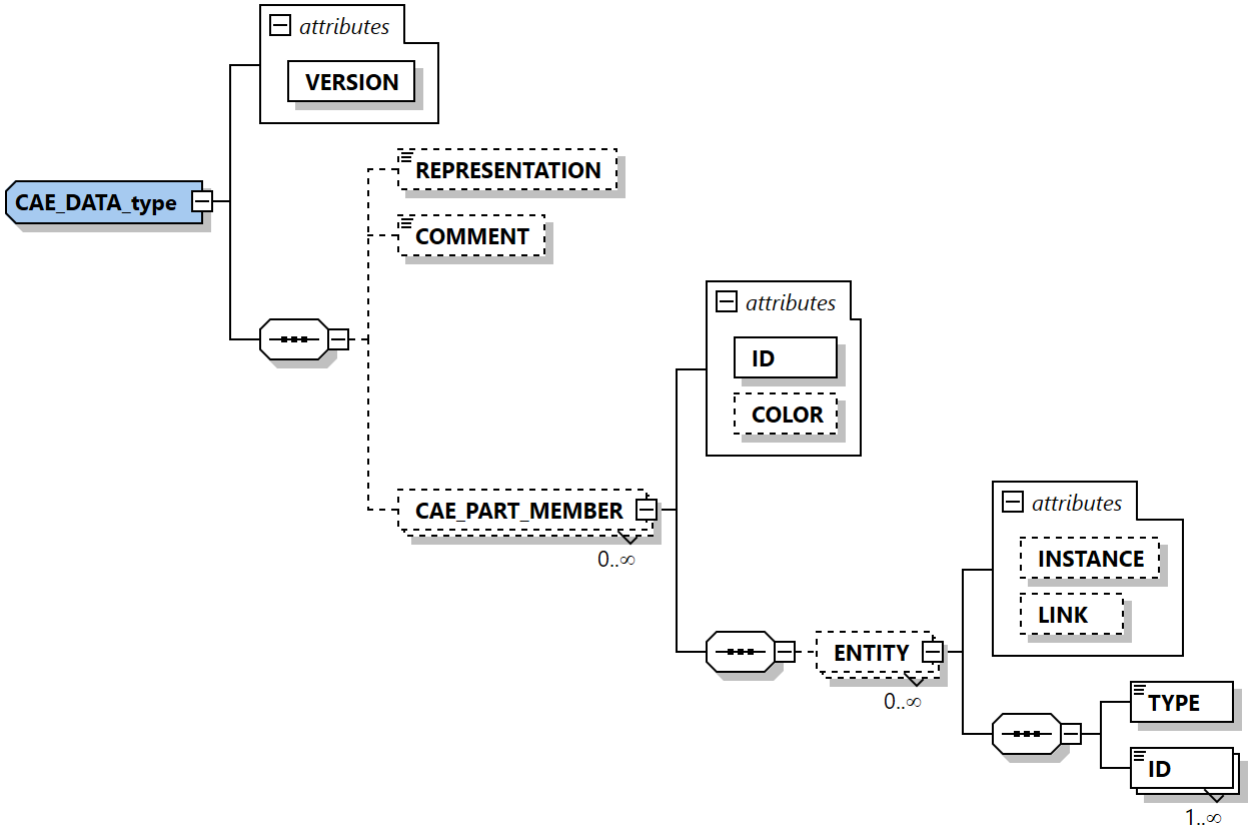
VERSION: *internal connection*: version depends on the part that connection belongs to.
external connection: version depends on the version of each part it connects.

DISCRETISATION: RBE3-HEXA, different than 'REPRESENTATION'

INSTANCE: - ? -

LINK: - ? -

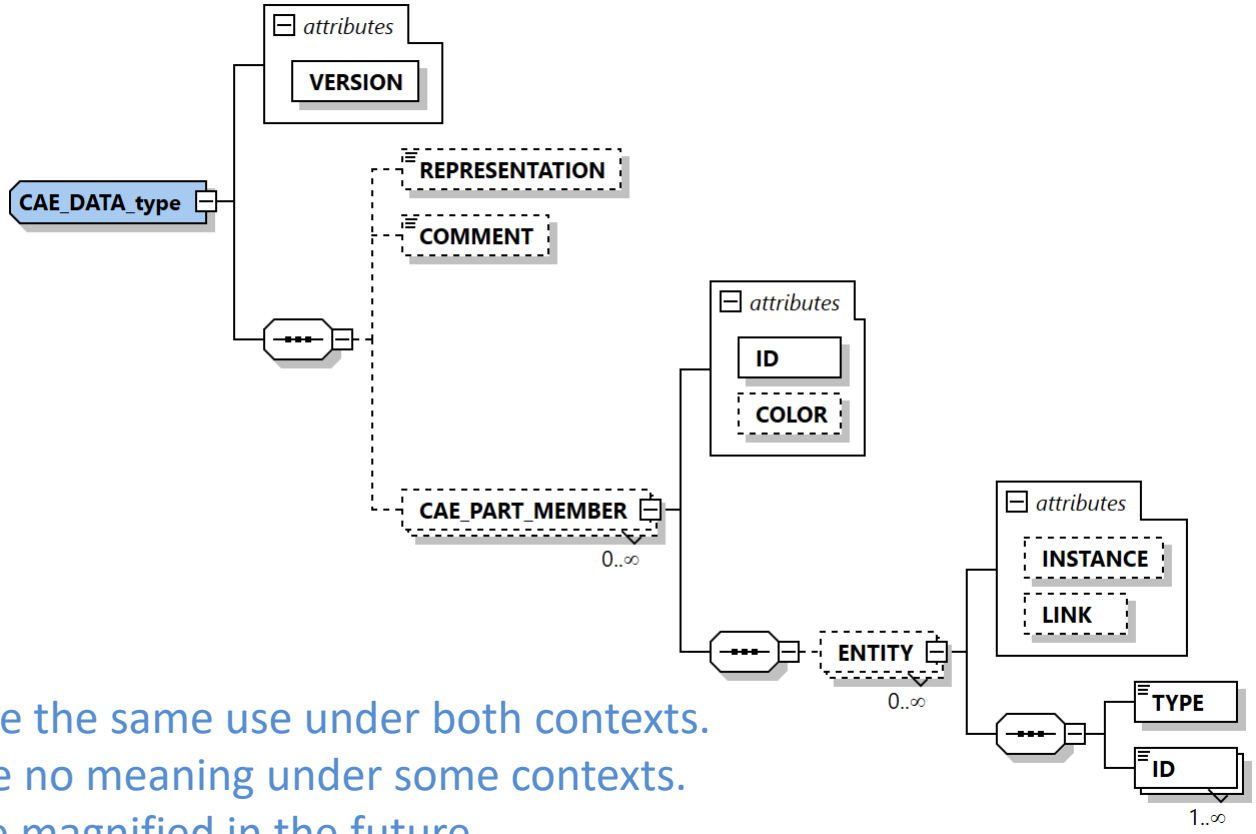
Issues with reuse of <CAE_DATA>:



Connections:

What does a multiple CAE_PART_MEMBERs mean in the context of Connections ?

Issues with reuse of <CAE_DATA>:



Conclusion:

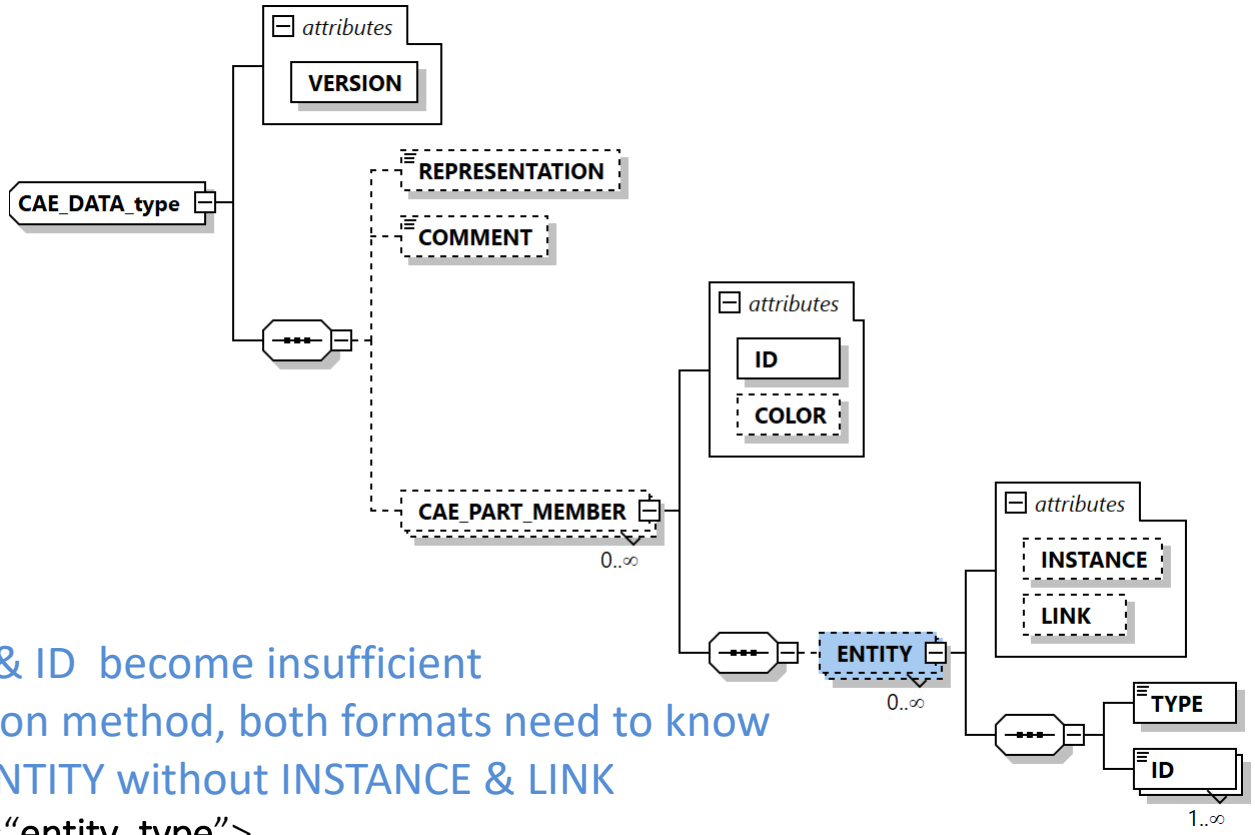
Attributes do not have the same use under both contexts.

Some attributes make no meaning under some contexts.

This may be magnified in the future.

- TYPE & ID may change due to introduction of a solver (ID may be 'name')
- INSTANCE, LINK, REPRESENTATION may change due to CAD domain. xMCF does not care.

Common Interest:



Proposal:

- If, someday, TYPE & ID become insufficient as an representation method, both formats need to know
- Hence, we need ENTITY without INSTANCE & LINK

```
<xs:complexType name="entity_type">
        <xs:sequence>
                <xs:element name="TYPE" minOccurs="1" maxOccurs="1"/>
                <xs:element name="ID" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
</xs:complexType>
```

Proposal:

```
<xs:complexType name="entity_type">
        <xs:sequence>
                <xs:element name="TYPE" minOccurs="1" maxOccurs="1"/>
                <xs:element name="ID" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
</xs:complexType>
```

```
<xmcf>
  ...
  <femdata>
    <solver>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
    </solver>
  </femdata>
</xmcf>
```

Here's how <entity> of <femdata> could look like in xMCF.

Proposal:

```
<xs:complexType name="entity_type">
        <xs:sequence>
                <xs:element name="TYPE" minOccurs="1" maxOccurs="1"/>
                <xs:element name="ID" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
</xs:complexType>
```

entity.xsd

```
<xmcf>
  ...
  <femdata>
    <solver>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
    </solver>
  </femdata>
</xmcf>
```

xml

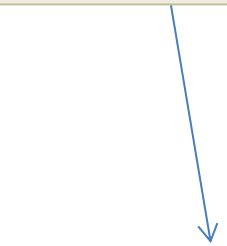
<femdata>, **<solver>**, ..., and **<entity>** are independent from FatXML.

But they both include **entity.xsd**, which contains the common type.

How to handle versioning of <entity> ?

```
<xmcf>
<version> 3.0.1 </version>
  ...
  <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

```
<xmcf>
<version> 3.2.0 </version>
  ...
 <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150-151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```



format of <entity> can change only when xmcf's <version> changes.

How to handle versioning of <entity> ?

```
<xmcf>
<version> 3.0.1 </version>
  ...
  <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

```
<xmcf>
<version> 3.2.0 </version>
  ...
 <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150-151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

2) format of <entity> can change only when xmcf's <version> changes.

Change in <entity> format demands xmcf <version> change.

entity version is dictated by xmcf.xsd

```
<xmcf>
<version> 3.0.1 </version>
  ...
  <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

```
<xmcf>
<version> 3.2.0 </version>
  ...
 <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150-151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

xmcf.xsd includes entity.xsd

format of <entity> is dictated by xmcf schema of current version, not by the producer of xml.

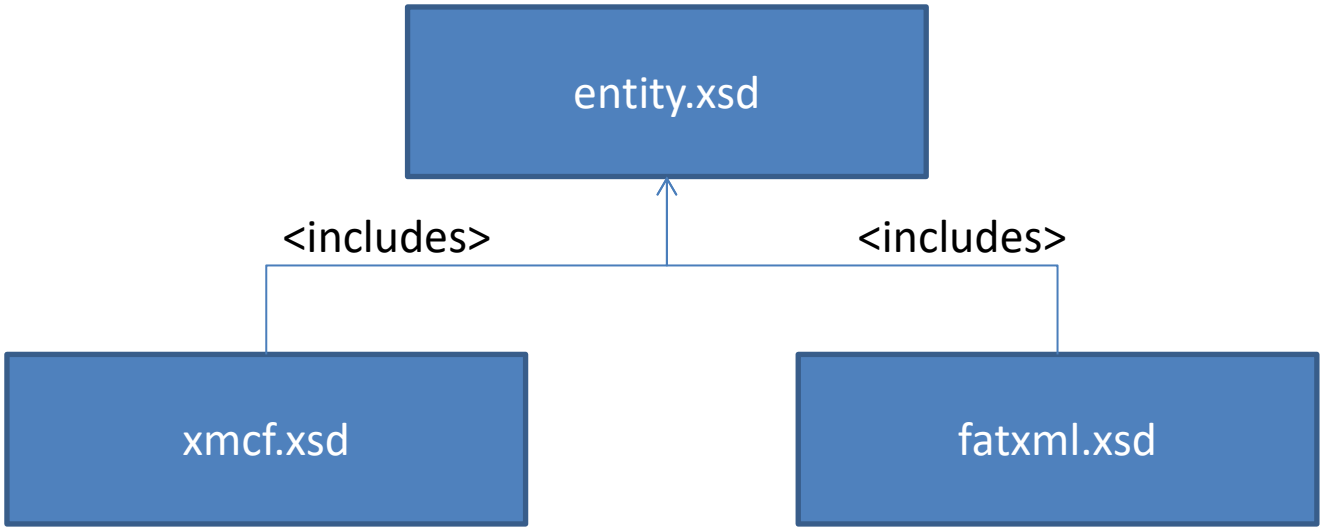
Case 2: entity version is dictated by xmcf.xsd

```
<xmcf>
<version> 3.0.1 </version>
  ...
  <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150</ID>
        <ID>151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

```
<xmcf>
<version> 3.2.0 </version>
  ...
 <femdata>
      <entity>
        <TYPE>CQUAD4</TYPE>
        <ID>150-151</ID>
      </entity>
      <entity>
        <TYPE>CBAR</TYPE>
        <ID>180</ID>
      </entity>
  </femdata>
</xmcf>
```

xMCF will change at a faster rate than the way elements are represented by solvers, so this is safe

Proposal Implementation:



Implementation proposal xmcf.xsd

entity.xsd

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
    <xs:complexType name="entity_type">
       <xs:sequence>
           <xs:element name="TYPE" minOccurs="1" maxOccurs="1"/>
           <xs:element name="ID" minOccurs="1" maxOccurs="unbounded"/>
        </xs:sequence>
    </xs:complexType>
</xs:schema>
```

```
<xmcf>
...
   <femdata>
      <NASTRAN>
          <entity>
              <TYPE>CQUAD4</TYPE>
              <ID>150</ID>
              <ID>151</ID>
          </entity>
          <entity>
              <TYPE>CBAR</TYPE>
              <ID>180</ID>
          </entity>
      </NASTRAN>
   </femdata>
</xmcf>
```

Both xMCF & FatXML will follow the Type/ID way of selecting the FEM elements

Implementation proposal xmcf.xsd

xmcf.xsd

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" ...>
  <xs:include schemaLocation="entity.xsd"/>
  <xs:element name="xmcf">
    ........
    <xs:complexType name="femdata_type">
        <xs:sequence>
            <xs:element name="entity" type="entity_type" minOccurs="0" maxOccurs="unb
        </xs:sequence>
    </xs:complexType>

    <xs:element name="femdata">
        <xs:complexType>
            <xs:all>
                <xs:element name="PAMCRASH" type="femdata_type" minOccurs="0" maxOccu
                <xs:element name="LSDYNA"   type="femdata_type" minOccurs="0" maxOccu
                ....
                <xs:element name="NASTRAN"  type="femdata_type" minOccurs="0" maxOccu
            </xs:all>
        </xs:complexType>
    </xs:element>
    .........
```

<entity_type is defined in entity.xsd>

Implementation proposal xmcf.xsd

xmcf.xsd

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" ...>
  <xs:include schemaLocation="entity.xsd"/>
  <xs:element name="xmcf">
    ........
    <xs:complexType name="femdata_type">
        <xs:sequence>
            <xs:element name="entity" type="ent
        </xs:sequence>
    </xs:complexType>

    <xs:element name="femdata">
        <xs:complexType>
            <xs:all>
                <xs:element name="PAMCRASH" typ
                <xs:element name="LSDYNA"   typ
                ....
                <xs:element name="NASTRAN"  typ
            </xs:all>
        </xs:complexType>
    </xs:element>
    .........
```

<entity_type is defined in entity.xsd>

```
<xmcf>
...
   <femdata>
      <NASTRAN>
          <entity>
              <TYPE>CQUAD4</TYPE>
              <ID>150</ID>
              <ID>151</ID>
          </entity>
          <entity>
              <TYPE>CBAR</TYPE>
              <ID>180</ID>
          </entity>
      </NASTRAN>
   </femdata>
</xmcf>
```

Implementation proposal fatxml.xsd

fatxml.xsd

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="entity.xsd"/>
  ........
  <xs:element name="CAE_DATA" minOccurs="0" maxOccurs="unbounded">
     <xs:complexType>
         .....
         <xs:element name="ENTITY" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
               <xs:complexContent>
                  <xs:extension base="entity_type">
                      <xs:attribute name="INSTANCE" type="xs:positiveInteger" use="op
                       <xs:attribute name="LINK" type="xs:string" use="optional" defa
                  </xs:extension>
               </xs:complexContent>
            </xs:complexType>
         </xs:element>
         ......
     </xs:complexType>
  </xs:element>
  .....
```

<entity_type is defined in entity.xsd>

Implementation proposal fatxml.xsd

fatxml.xsd

```
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:include schemaLocation="entity.xsd"/>
  ........
  <xs:element name="CAE_DATA" minOccurs="0" maxOccurs="unbounded">
     <xs:complexType>
         .....
         <xs:element name="ENTITY" minOccurs="0"
            <xs:complexType>
               <xs:complexContent>
                  <xs:extension base="entity_typ
                      <xs:attribute name="INSTAN
                       <xs:attribute name="LINK"
                  </xs:extension>
               </xs:complexContent>
            </xs:complexType>
         </xs:element>
         ......
     </xs:complexType>
  </xs:element>
  .....
```

```
<CAE_META_DATA>
...
   <CAE_DATA VERSION="02">
      <REPRESENTATION/>
      <CAE_PART_MEMBER ID="1">
          <ENTITY INSTANCE='5'>
              <TYPE>CQUAD4</TYPE>
              <ID>150</ID>
              <ID>151</ID>
          </ENTITY>
          <ENTITY>
              <TYPE>CBAR</TYPE>
              <ID>180</ID>
          </ENTITY>
      </CAE_PART_MEMBER>
   </CAE_DATA>
</CAE_META_DATA>
```

thank you!