Processing XML and Spreadsheet in Go

续 日

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Self Introduction

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The author of the Excelize - Go language spreadsheet library. Familiar with Go language programming, middleware, and big data solution.

Working Experiences

Alibaba Group - Software Engineer
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GopherChina 2021

Agenda

01 Serialize and Deserialize

- Document Object Model
- Event-driven (Simple API for XML)
- Serialize and Deserialize Control

02 Handle Complex XML

- Partial Load
- Namespace & Entity
- Ser/Deserialize Idempotence

03 High Performance Processing

- XML Schema Definition
- DOM or SAX

04 OOXML Spreadsheets

- Excel XML Specification
- Charset Encoding
- Streaming I/O

Serialize and Deserialize

Document Object Model

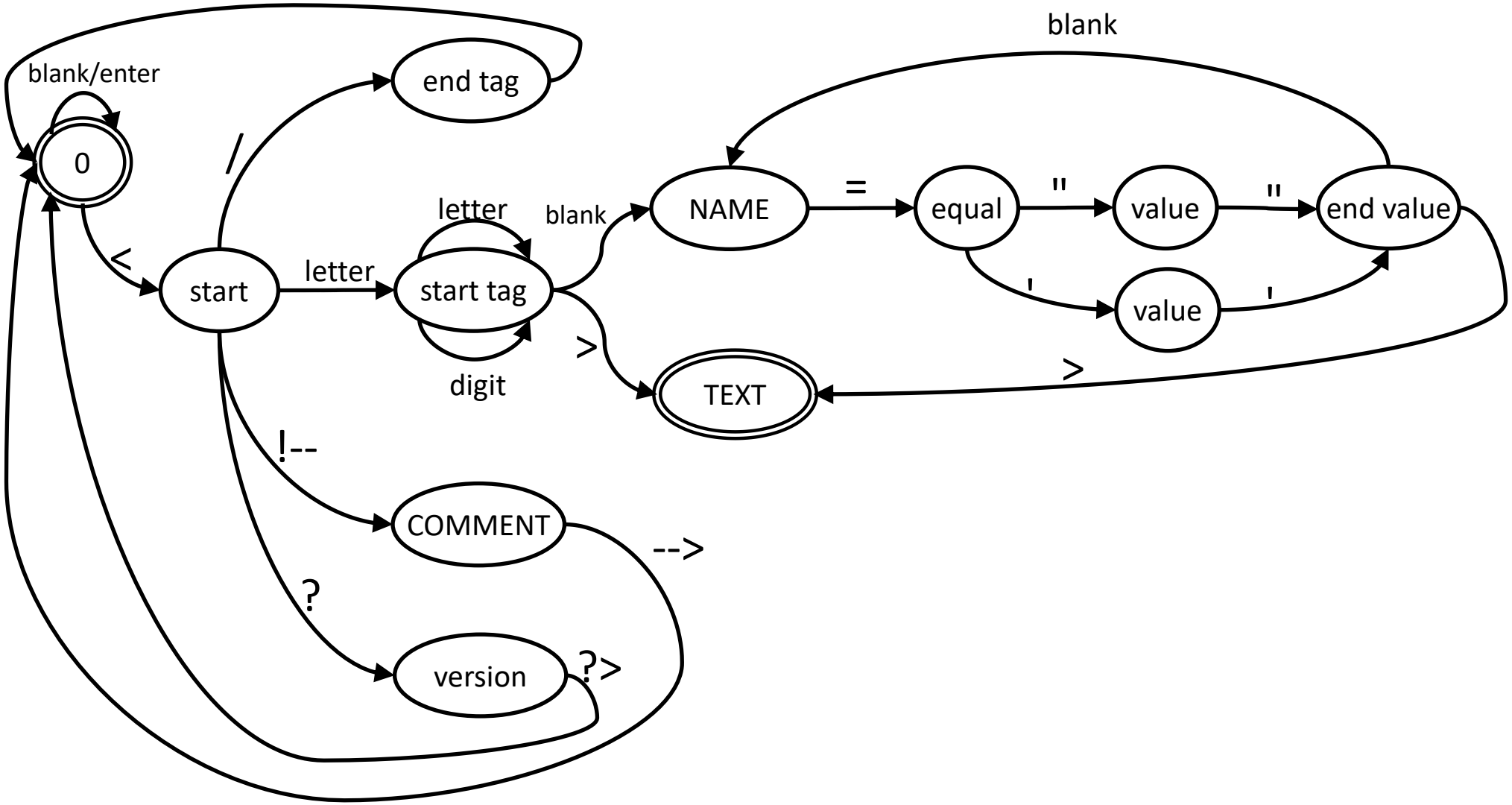
```
<?xml version="1.0" encoding="utf-8"?>
<Person>
    <Name>Tom</Name>
    <Email where="home">
        <Addr>tom@example.com</Addr>
    </Email>
</Person>
```

```
type Person struct {
    Name string
    Email struct {
        Where string `xml:"where,attr"`
        Addr string
    }
}
```

encoding/xml

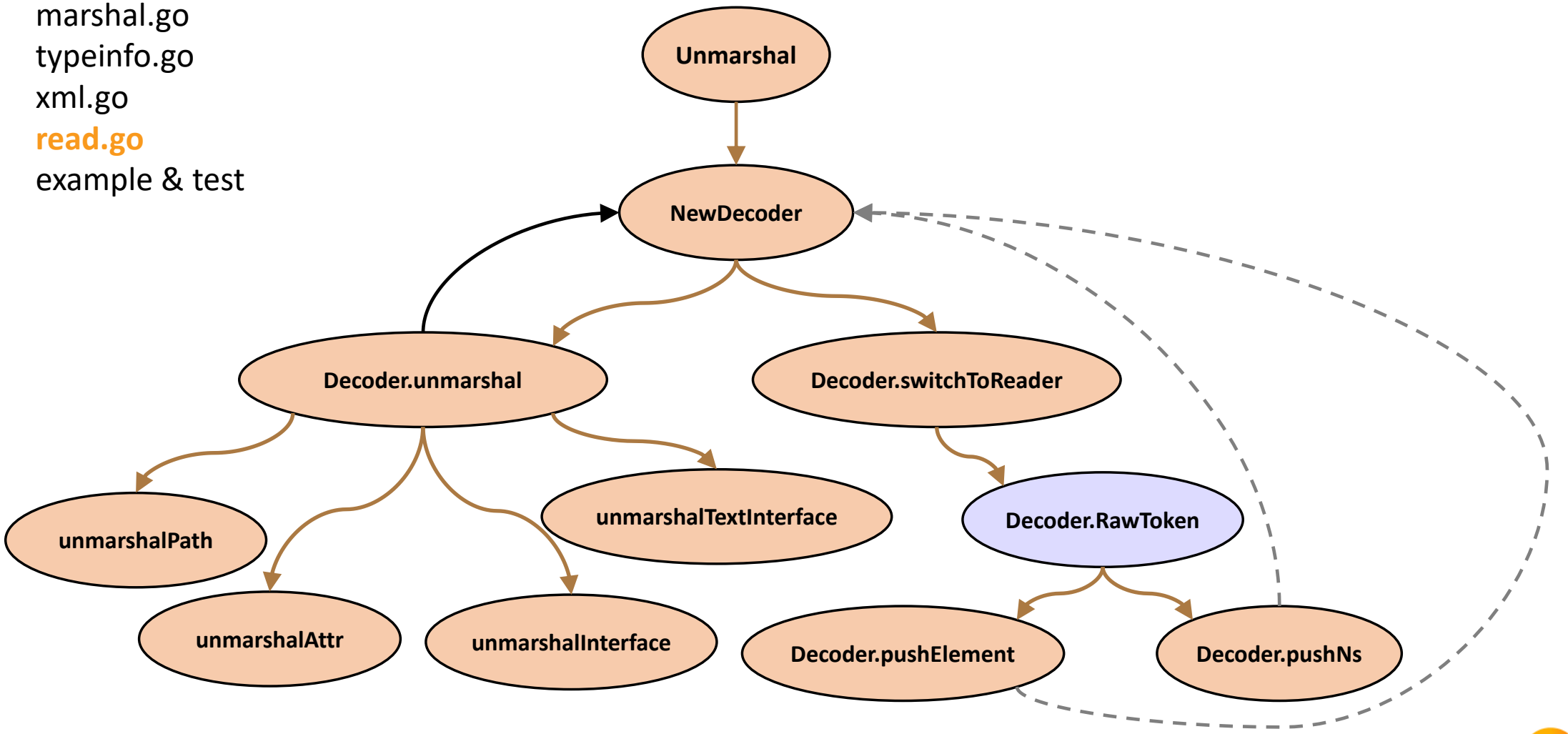
```
var p Person
if err := xml.Unmarshal([]byte(data), &p); err != nil {
    fmt.Println(err)
}
fmt.Printf("%+v\n", p)

// {Name:Tom Email:{Where:home Addr:tom@example.com}}
```

XML Finite State Machine



Unmarshal

encoding/xml
- marshal.go
- typeinfo.go
- xml.go
- **read.go**
- example & test



Go XML Parser

encoding/xml:xml.go

```
type Decoder struct {
    Strict              bool
    AutoClose           []string
    Entity              map[string]string
    CharsetReader       func(charset string, input io.Reader) (io.Reader, error)
    DefaultSpace        string
    r                   io.ByteReader
    t                   TokenReader
    buf                 bytes.Buffer
    saved               *bytes.Buffer
    stk                 *stack
    free                *stack
    needClose           bool
    toClose             Name
    nextToken           Token
    nextByte            int
    ns                  map[string]string
    err                 error
    line                int
    offset              int64
    unmarshalDepth      int
}
```

StartElement

EndElement

CharData

Comment

ProcInst

Directive

Event-driven (Simple API for XML)

```xml
<?xml version="1.0" encoding="utf-8"?>
<Person>
    <Name>Tom</Name>
    <Email where="home">
        <Addr>tom@example.com</Addr>
    </Email>
</Person>
```

```go
decoder := xml.NewDecoder(strings.NewReader(data))
for {
    token, _ := decoder.Token()
        if token == nil {
        break
    }
    switch element := token.(type) {
    case xml.StartElement:
        fmt.Printf("%+v\n", element)
    case xml.EndElement:
        fmt.Printf("%+v\n", element)
    }
}
```

```
{Name:{Space: Local:Person} Attr:[]}
{Name:{Space: Local:Name} Attr:[]}
{Name:{Space: Local:Name}}
{Name:{Space: Local:Email} Attr:[{Name:{Space: Local:where} Value:home}]}
{Name:{Space: Local:Addr} Attr:[]}
{Name:{Space: Local:Addr}}
{Name:{Space: Local:Email}}
{Name:{Space: Local:Person}}
```

Serialize and Deserialize Control

encoding/xml:typeinfo.go

```go
switch flag {
case "attr":
    finfo.flags |= fAttr
case "cdata":
    finfo.flags |= fCDATA
case "chardata":
    finfo.flags |= fCharData
case "innerxml":
    finfo.flags |= fInnerXML
case "comment":
    finfo.flags |= fComment
case "any":
    finfo.flags |= fAny
case "omitempty":
    finfo.flags |= fOmitEmpty
}
```

```go
type Person struct {
    Name string
    Email struct {
        Where string `xml:"where,attr,omitempty"`
        Addr  string
    }
}
```

- attribute with the field name in the XML element
- written as character data, not as an XML element
- written as character data wrapped in one or more <![CDATA[...]]> tags
- written verbatim, not subject to the usual marshaling procedure
- unmatched rule, maps the sub-element to that struct field
- omitted if the field value is empty

Partial Load

```
<?xml version="1.0" encoding="utf-8"?>
<Person>
    <Name>Tom</Name>
    <Email>
        <Addr>tom@example.com</Addr>
    </Email>
</Person>
```

```go
type Person struct {
    Name string
    Email partialXML
}

type partialXML struct {
    Content string `xml:",innerxml"`
}
```

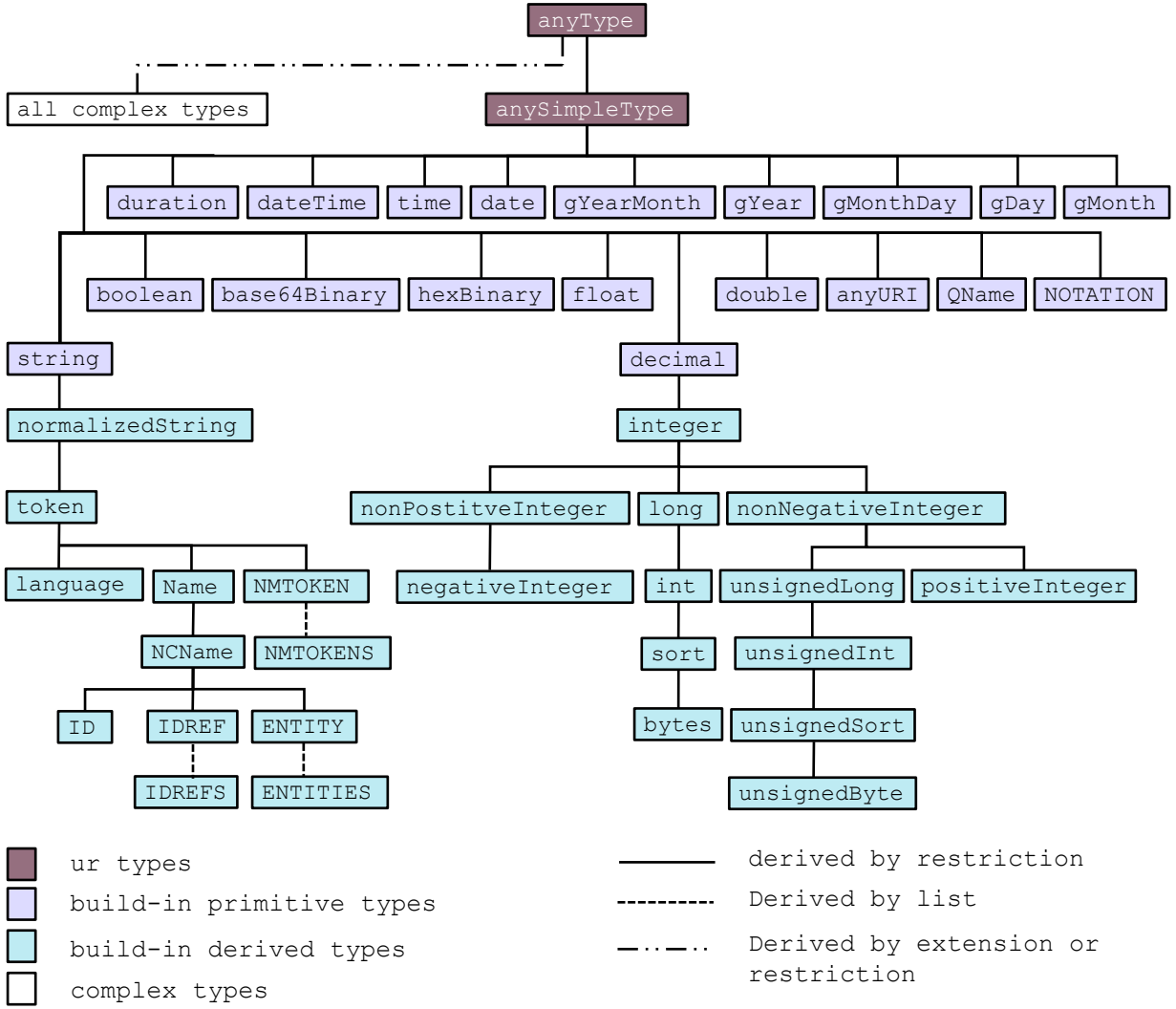
```go
var p Person
err := xml.Unmarshal([]byte(data), &p)
if err != nil {
    fmt.Println(err)
}
fmt.Printf("%+v\n", p)
```

```
{Name:Tom Email:{Content:
    <Addr>tom@example.com</Addr>
}}
```

Handle Complex XML

Datatypes

Go Datatypes	XML Datatypes
string	anyType, ENTITY,ID, IDREF, NCName, NMTOKEN, Name, anyURI, duration, language, normalizedString, string, token, xml:lang, xml:space, xml:base,xml:id
[]string	ENTITIES, IDREFS, NMTOKENS, NOTATION
xml.Name	QName
[]byte	base64Binary, hexBinary, unsignedByte
bool	boolean
byte	byte
float64	decimal, double, float,
int64	int, integer, long, negativeInteger, nonNegativeInteger, nonPositiveInteger, positiveInteger, short
uint64	unsignedInt, unsignedLong, unsignedShort
time.Time	date, dateTime, gDay, gMonth, gMonthDay, gYear, gYearMonth,time



Entity

XML Entity

```
<?xml version="1.0" encoding="utf-8"?>

<!DOCTYPE person[
    <!ENTITY name "Tom">
    <!ENTITY email "tom@example.com">
]>

<person>
    <name>&name;</name>
    <address>&email;</address>
</person>
```

```go
type Person struct {
     XMLName xml.Name `xml:"person"`
     Name    string   `xml:"name"`
     Address string   `xml:"address"`
}
```

Get Entity

```go
exp := `<!ENTITY\s+([^\s]+)\s+"([^"]+)">`
entities := map[string]string{}
d := xml.NewDecoder(strings.NewReader(input))
var rEntity = regexp.MustCompile(exp)
for {
     tok, err := d.Token()
     if err != nil {
          break
    }
    dir, ok := tok.(xml.Directive)
    if !ok {
         continue
    }
    fmt.Println(string(dir))
    for _, m := range rEntity.FindAllSubmatch(dir,-1) {
          entities[string(m[1])] = string(m[2])
    }
}
fmt.Println("entities", entities)
```

```
entities map[name:Tom email:tom@example.com]
```

Entity

XML Entity

```
<?xml version="1.0" encoding="utf-8"?>

<!DOCTYPE person[
    <!ENTITY name "Tom">
    <!ENTITY email "tom@example.com">
]>

<person>
    <name>&name;</name>
    <address>&email;</address>
</person>
```

```go
type Person struct {
     XMLName xml.Name `xml:"person"`
     Name    string   `xml:"name"`
     Address string   `xml:"address"`
}
```

Decode with Entity

```go
d = xml.NewDecoder(strings.NewReader(input))
d.Strict = false

d.Entity = entities
err := d.Decode(&v)
if err != nil {
    fmt.Printf("error: %v", err)
    return
}
fmt.Printf("%+v\n", v)
```

```
{XMLName:{Space: Local:company} Name:Jack Address:Tom}
```

Namespace & Ser/Deserialize Idempotence

```
<?xml version="1.0" encoding="utf-8"?>
<person
    xmlns="http://example.com/default"
    xmlns:m="http://example.com/main"
    xmlns:h="http://example.com/home"
    xmlns:w="http://example.com/work">
    <name>Tom</name>
    <m:email h:addr="HOME" w:addr="WORK" />
</person>
```

```
<person xmlns="http://example.com/default">
<name>Tom</name>
<email xmlns="http://example.com/main"
    xmlns:home="http://example.com/home"
    home:addr="HOME"
    xmlns:work="http://example.com/work"
    work:addr="WORK"></email>
</person>
```

Inline Namespace Declare

Namespace

Local Name

```
type Person struct {
    XMLName  xml.Name `xml:"http://example.com/default person"`
    Name     string   `xml:"name"`
    Email    struct {
        XMLName  xml.Name `xml:"http://example.com/main email"`
        HomeAddr string   `xml:"http://example.com/home addr,attr"`
        WorkAddr string   `xml:"http://example.com/work addr,attr"`
    } // TAG NOT HERE: `xml:"email"`
}
```

Root Element
NS Missing!

Ser/Deserialize Idempotence

encoding/xml:xml.go

```go
type Name struct {
    Space, Local string
}

type Attr struct {
    Name Name
    Value string
}

type StartElement struct {
    Name Name
    Attr []Attr
}

type Token interface{}

type EndElement struct {
    Name Name
}
```

```go
// getRootEleAttr extract root element attributes by
// given XML decoder.
func getRootEleAttr(d *xml.Decoder) []xml.Attr {
    tokenIdx := 0
    for {
        token, _ := d.Token()
        if token == nil {
            break
        }
        switch startElement := token.(type) {
        case xml.StartElement:
            tokenIdx++
            if tokenIdx == 1 {
                return startElement.Attr
            }
        }
    }
    return nil
}
```

Ser/Deserialize Idempotence

```xml
<?xml version="1.0" encoding="utf-8"?>
<person
    xmlns="http://example.com/default"
    xmlns:m="http://example.com/main"
    xmlns:h="http://example.com/home"
    xmlns:w="http://example.com/work">
    <name>Tom</name>
    <m:email h:addr="HOME" w:addr="WORK" />
</person>
```

```xml
<?xml version="1.0" encoding="utf-8"?>
<person xmlns="http://example.com/default"
    xmlns:m="http://example.com/main"
    xmlns:h="http://example.com/home"
    xmlns:w="http://example.com/work" >
    <name>Tom</name>
    <email xmlns="http://example.com/main"
      xmlns:home="http://example.com/home"
      home:addr="HOME"
      xmlns:work="http://example.com/work"
      work:addr="WORK"></email>
</person>
```

```go
decoder := xml.NewDecoder(strings.NewReader(data))
marshalXML := ""
for {
    token, _ := decoder.Token()
    if token == nil {
        break
    }
    switch element := token.(type) {
    case xml.StartElement:
        for _, attr := range element.Attr {
            if element.Name.Local == "person" {
                colon := ""
                if attr.Name.Space != "" {
                    colon = ":"
                }
                marshalXML += fmt.Sprintf("%s%s%s=\"%s\" ",
                attr.Name.Space, colon,
                attr.Name.Local, attr.Value)
            }
        }
    }
}
fmt.Printf("<person %s>\n", marshalXML)
```

High Performance Processing

XML Components Data Model

```
<?xml version="1.0"?>
<note xmlns:m="http://example.com/main">
    <to>Tom</to>
    <from>Bob</from>
    <heading>Reminder</heading>
    <m:body>Don't forget me this weekend!</m:body>
</note>
```

shared.xsd

```
<?xml version="1.0"?>
<xs:schema
   xmlns:xs="http://www.w3.org/2001/XMLSchema">
    <xs:element name="body" type="xs:string"/>
</xs:schema>
```

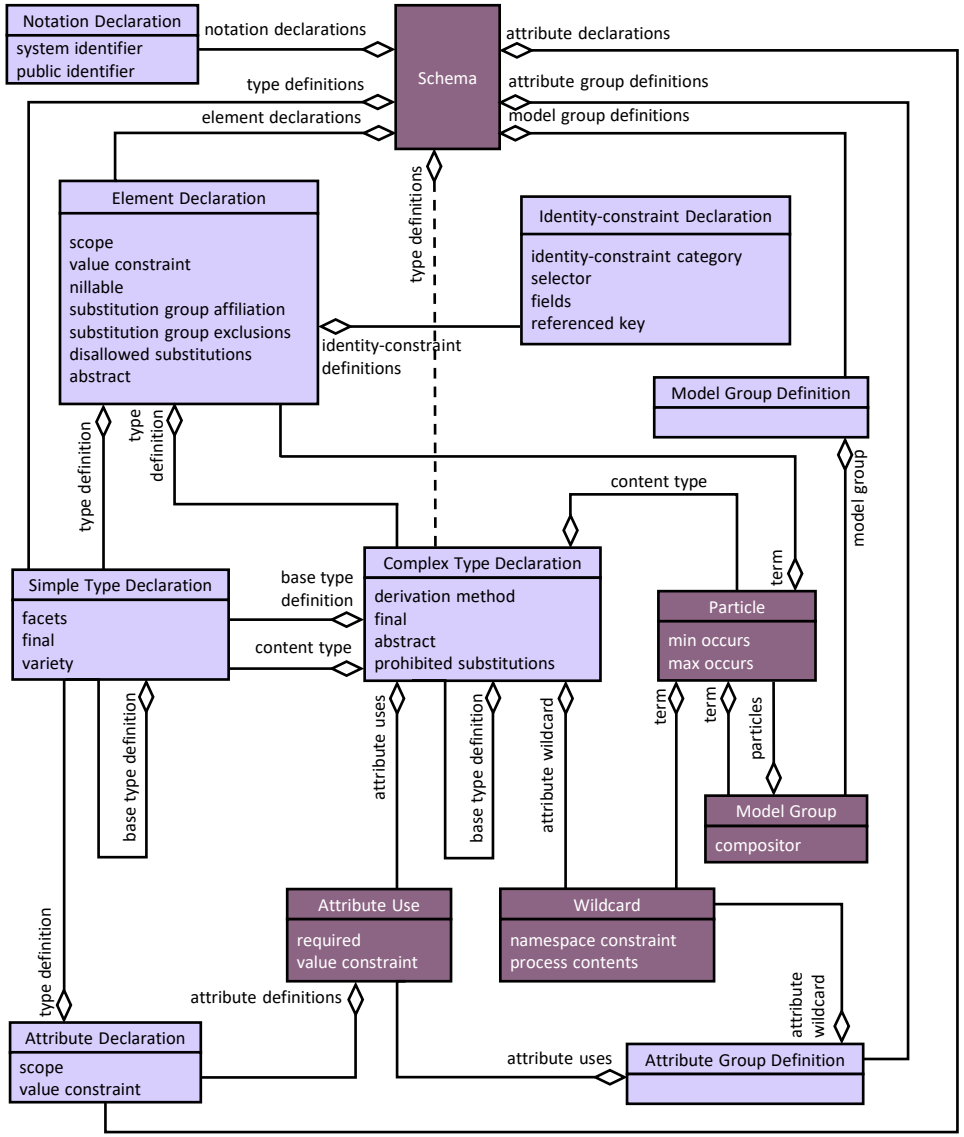
```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:m="http://example.com/main">
<xsd:import namespace="http://example.com/main" schemaLocation="shared.xsd"/>
<xs:element name="note">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="to" type="xs:string"/>
                <xs:element name="from" type="xs:string"/>
                <xs:element name="heading" type="xs:string"/>
                <xs:element name="m:body" use="required"/>
            </xs:sequence>
        </xs:complexType>
    </xs:element>
</xs:schema>
```

XML Components Data Model

```
<?xml version="1.0"?>
<note xmlns:m="http://example.com/main">
    <to>Tom</to>
    <from>Bob</from>
    <heading>Reminder</heading>
    <m:body>Don't forget me this weekend!</m:body>
</note>
```

```go
type Note struct {
    XMLName xml.Name `xml:"note"`
    To      string   `xml:"to"`
    From    string   `xml:"from"`
    Heading string   `xml:"heading"`
    Body    string   `xml:"http://example.com/main body"`
}
```

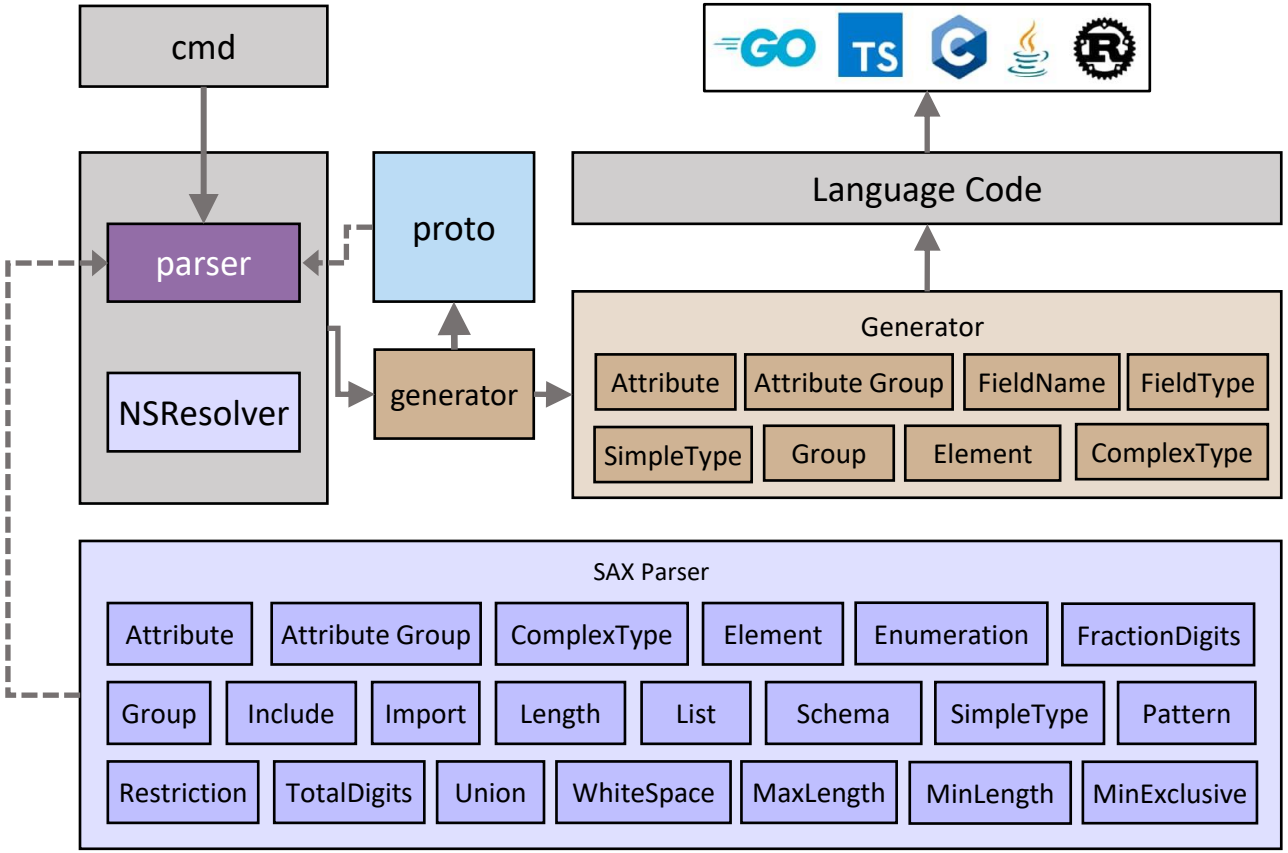
XML Components Data Model



is a named component and has two additional properties - name and target namespace

is an un-named component

XSD: XML Schema Definition Process https://github.com/xuri/xgen

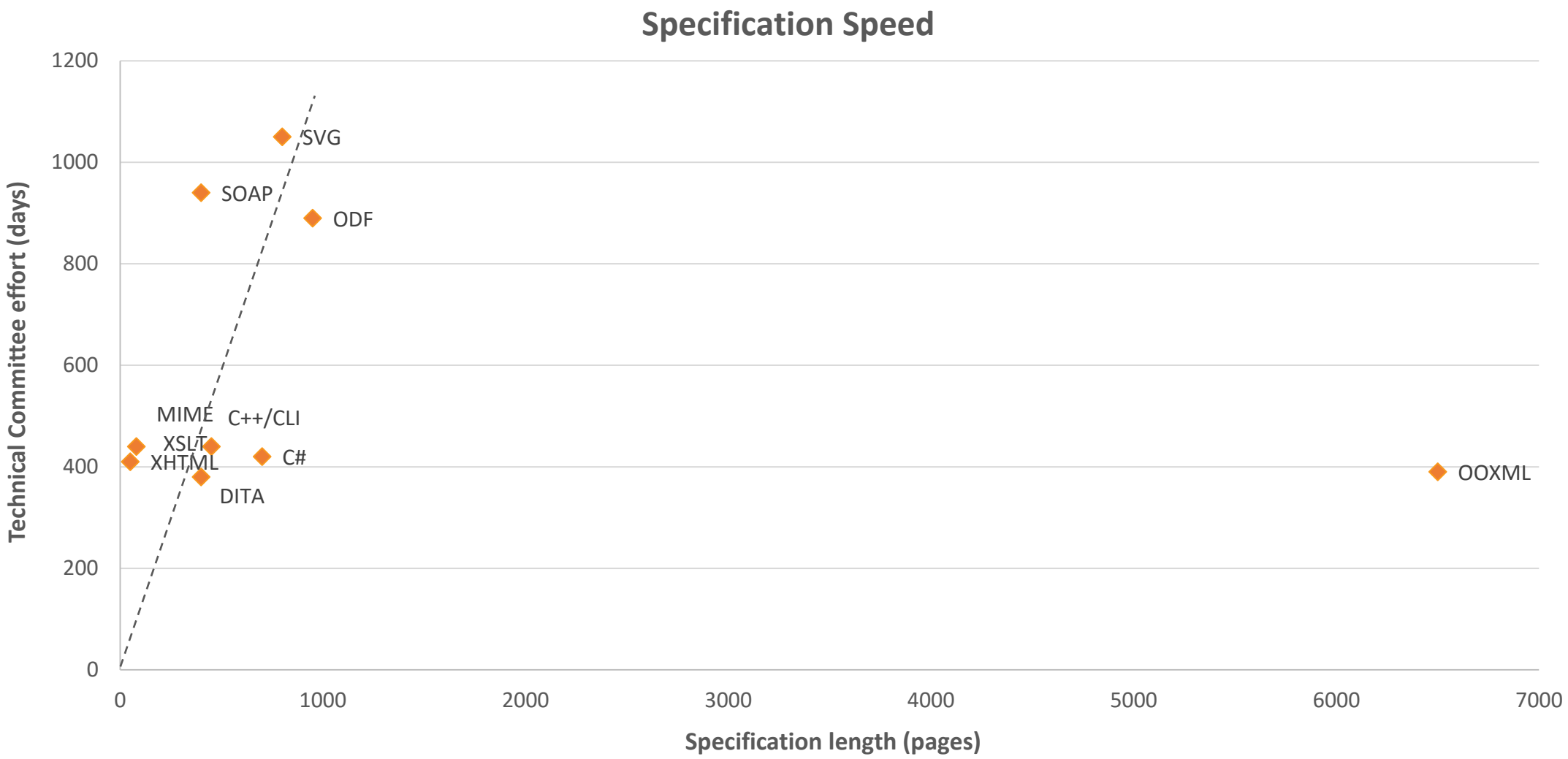


SAX or DOM

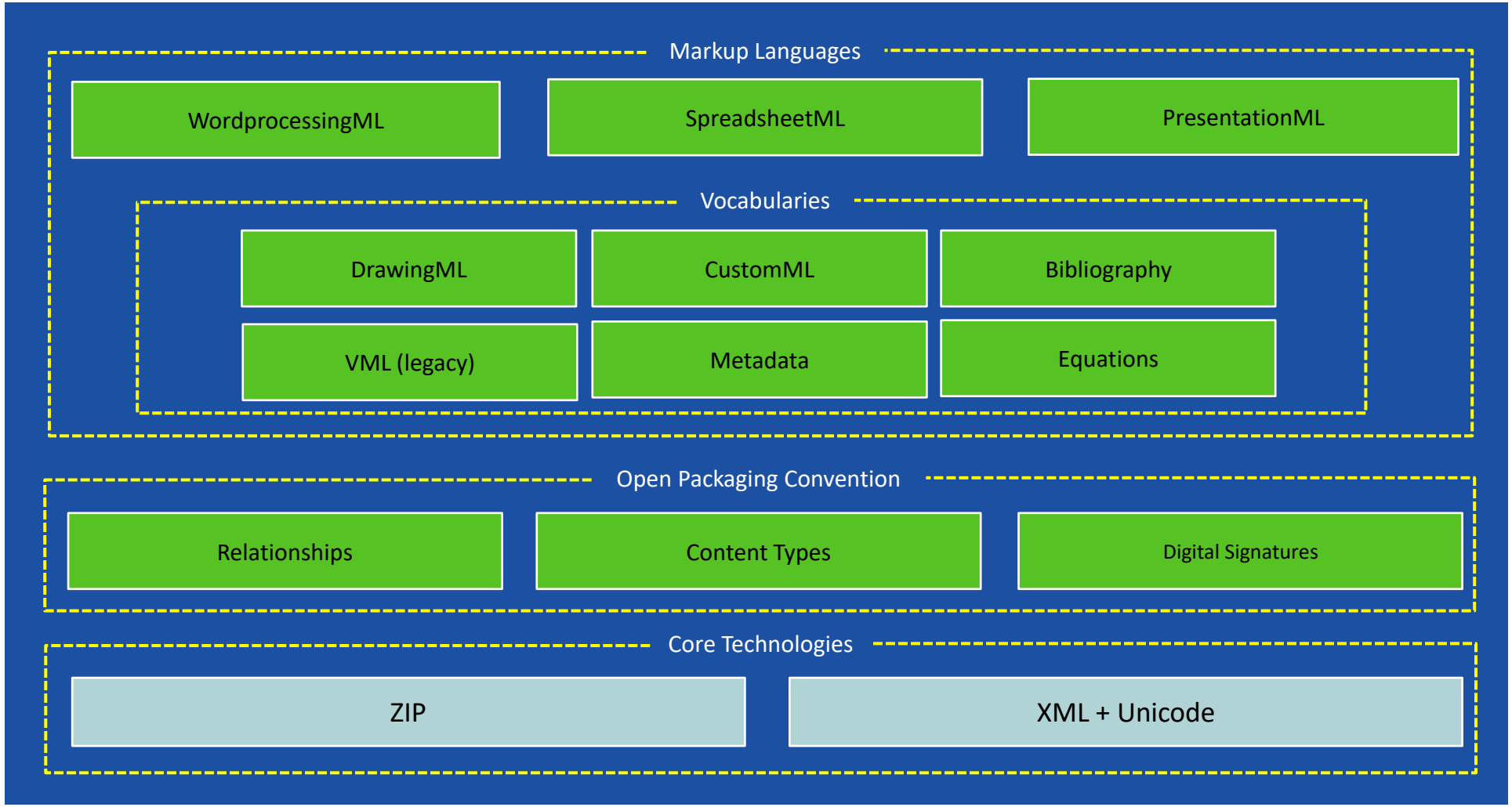
SAX Parser	DOM Parser
Simple API for XML Parsing	Document Object Model
Event-based parser	Stays in a tree structure
Low memory usage	High memory usage
Best for the larger size of XML files	Best for the smaller sizes of files
Read-only	Insert or delete nodes
Backward navigation is not possible	Backward and forward search is possible
A small part of the XML file is only loaded in memory	It loads whole XML documents in memory

OOXML Spreadsheets

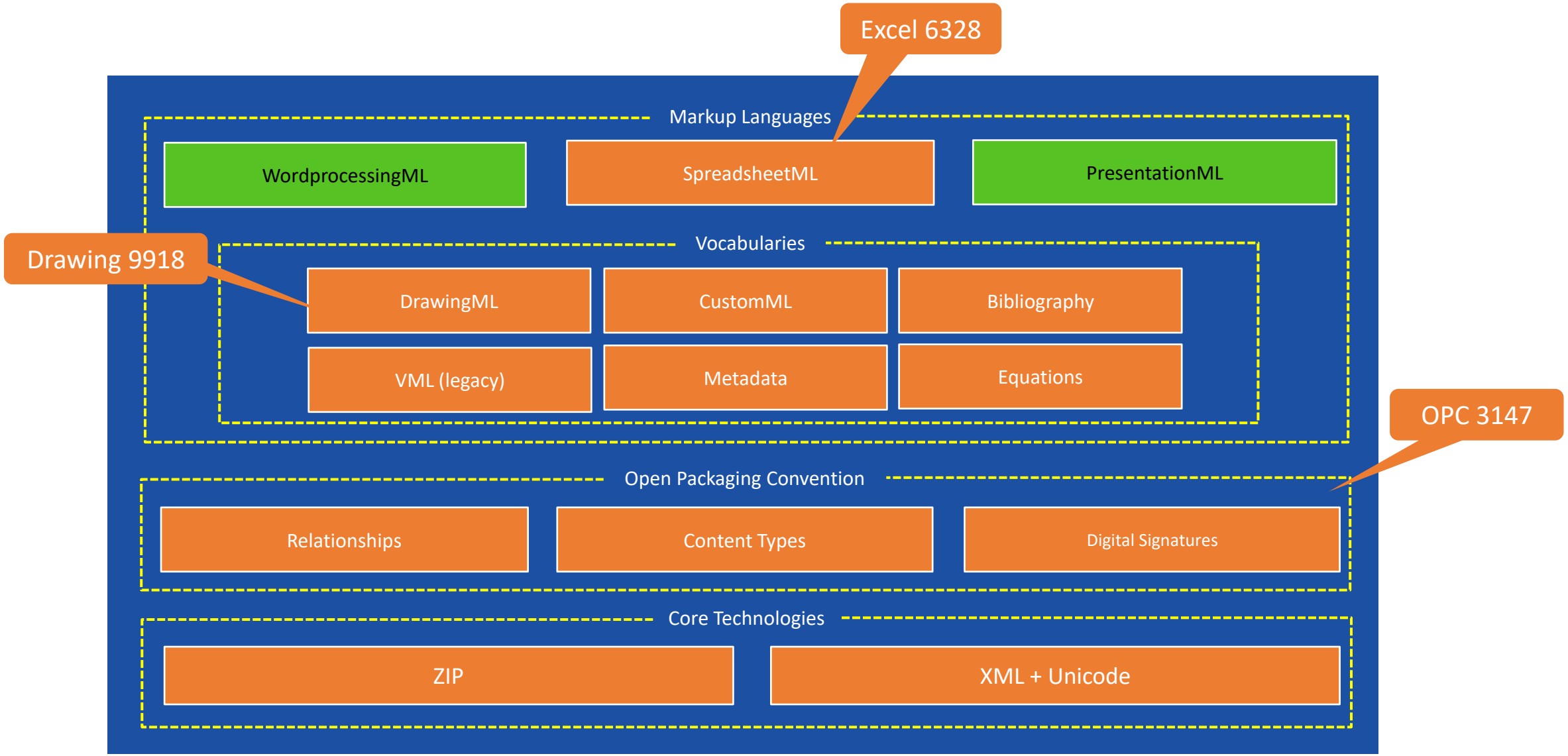
OOXML ISO/IEC 29500 ECMA-376 Specification



OOXML Specification



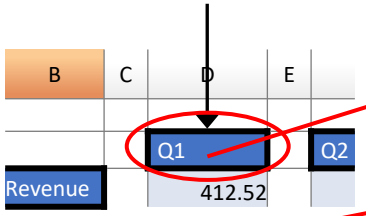
OOXML Specification



Typical XML of the Cell

Over 10589
Elements & Attributes

Start




```
<c r="D3" s="7" t="s">
  <v>0</v>
</c>
```

```
<xf numFmtId="0" fontId="4" fillId="2" borderId="2" xfId="1" applyBorder="1" />
```

(build-in)

```
<font>
  <sz val="11"/>
  <color theme="0"/>
  <name val="Calibri"/>
  <scheme val="minor"/>
</font>
```

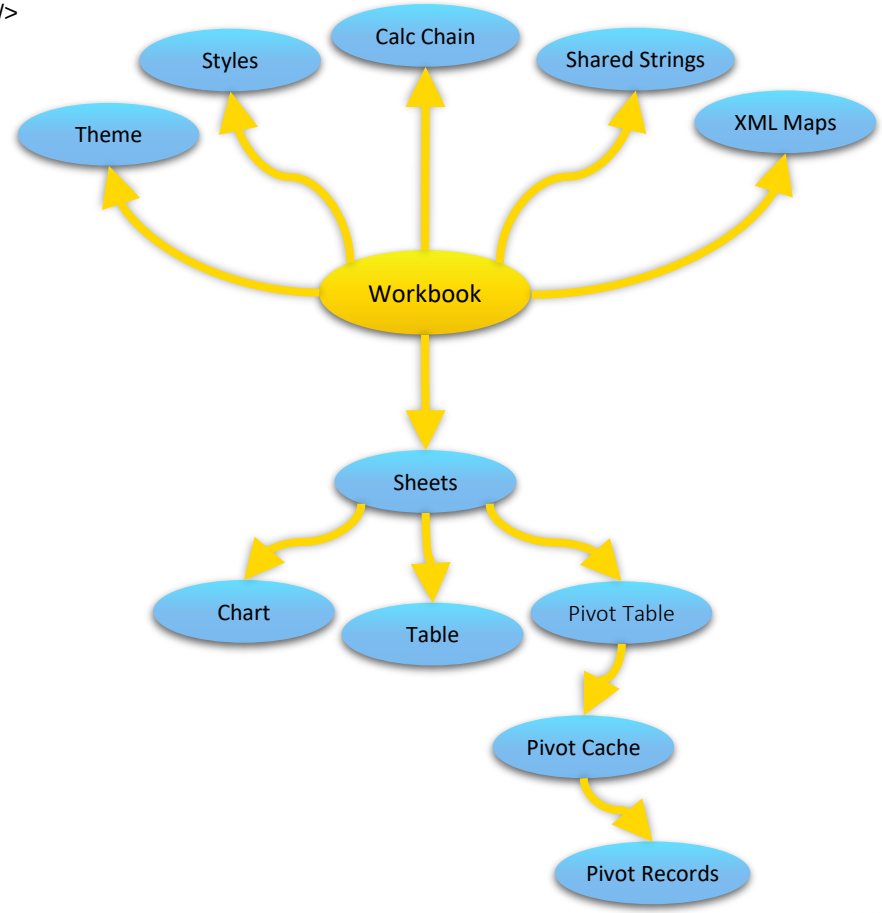
```
<fill>
  <patternFill patternType="solid">
    <fgColor theme="4"/>
    <bgColor theme="4"/>
  </patternFill>
</fill>
```

```
<border>
  <left style="thick">
    <color auto="1"/>
  </left>
  <right style="thick">
    <color auto="1"/>
  </right>
  <top style="thick">
    <color auto="1"/>
  </top>
  <bottom style="thick">
    <color auto="1"/>
  </bottom>
  <diagonal/>
</border>
```

```
<a:theme xmlns:a="http://schemas.openxmlformats.org
  <a:themeElements>
    <a:clrScheme name="Office">
      <a:dk1>
        <a:sysClr val="windowText" />
      </a:dk1>
      <a:lt1>
        <a:sysClr val="window" />
      </a:lt1>
      <a:dk2>
        <a:srgbClr val="1F497D"/>
      </a:dk2>
      <a:lt2>
        <a:srgbClr val="FAF3E8"/>
      </a:lt2>
      <a:accent1>
        <a:srgbClr val="5C93B4"/>
      </a:accent1>
```

```
<cellStyleXfs count="12">
  <xf numFmtId="0" fontId="0" fillId="0" borderId="0"/>
  <xf numFmtId="0" fontId="4" fillId="2" borderId="0" applyBorder="1" applyAlignment="1" applyProtection="1"/>
    </protection>
  </xf>
```

```
<cellStyles count="2">
  <cellStyle name="Accent1" xfId="1" builtinId="29"/>
```



Charset Encoding

228 Labels

```
<?xml version='1.0' encoding='character encoding' standalone='yes|no'?>
```

Name	Labels
UTF-8	6
Legacy single-byte encodings	168
Legacy multi-byte Chinese (simplified) encodings	10
Legacy multi-byte Chinese (traditional) encodings	5
Legacy multi-byte Japanese encodings	13
Legacy multi-byte Korean encodings	10
Legacy miscellaneous encodings	16

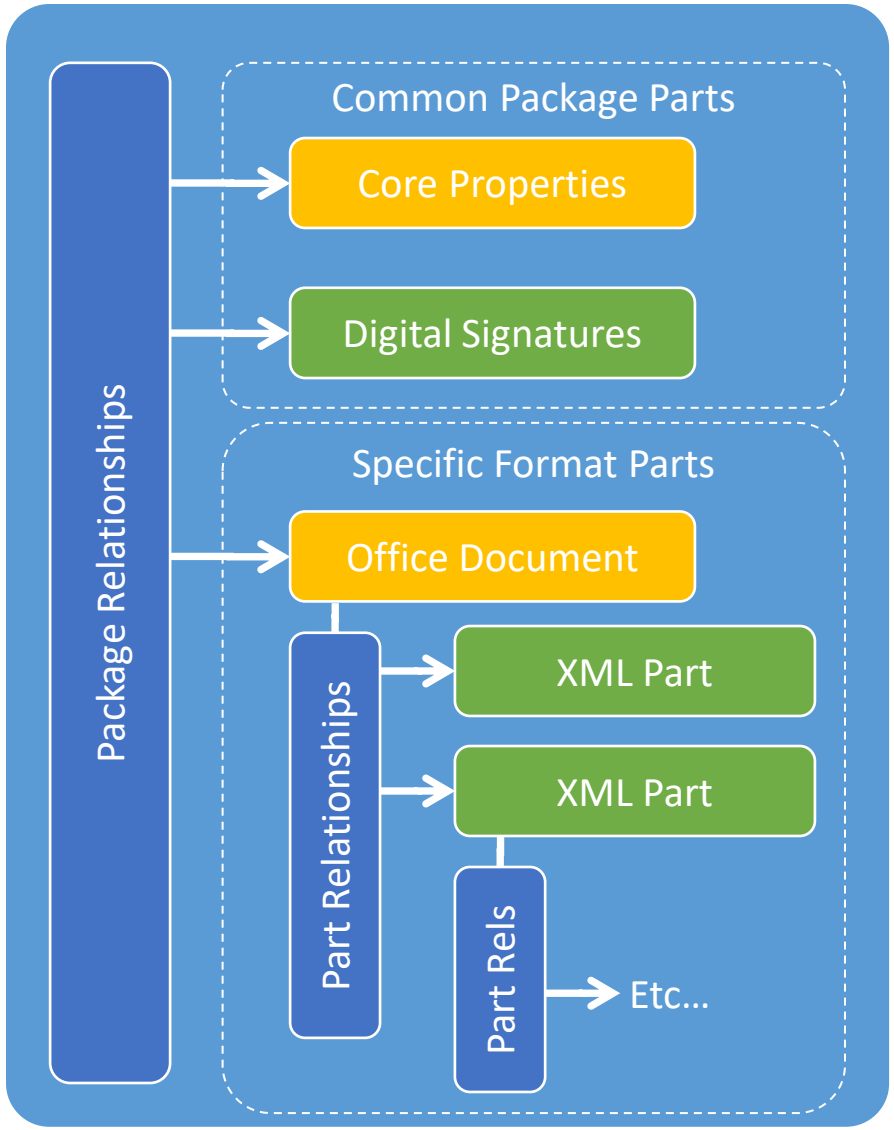
Ref: https://encoding.spec.whatwg.org

```go
import (
    "golang.org/x/net/html/charset”
    "golang.org/x/text/encoding"
    "golang.org/x/text/encoding/charmap"
)
decoder = xml.NewDecoder(strings.NewReader(data))
decoder.CharsetReader = charset.NewReaderLabel
```

Custom Charset Reader

```go
// CharsetReader Decoder from all codepages to UTF-8
func CharsetReader(charset string, input io.Reader) io.Reader {
    var enc encoding.Encoding
    for i := range charmap.All {
    item = charmap.All[i]
        if strings.EqualFold(sm, nm) {
            enc = item
        }
    }
    return enc.NewDecoder().Reader(input)
}
```

Streaming I/O



	A	B	C
1			
2		123	
3			
4			

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<worksheet
xmlns="http://schemas.openxmlformats.org/spreadsheetml/2006/main"
xmlns:mc="http://schemas.openxmlformats.org/markup-compatibility/2006">
	<dimension ref="B2"/>
	<sheetViews>
		<sheetView tabSelected="1" workbookViewId="0" />
	</sheetViews>
	<sheetFormatPr baseColWidth="10" defaultRowHeight="16" />
	<sheetData>
		<row r="2">
			<c r="B2">
				<v>123</v>
			</c>
		</row>
	</sheetData>
	<pageMargins left="0.7" right="0.7" />
</worksheet>
```

Set Row

```
<sheetData>
    <row r="2">
        <c r="B2">
            <v>123</v>
        </c>
    </row>
</sheetData>
```

```go
type StreamWriter struct {
  File            *File
  Sheet           string
  SheetID         int
  worksheet       *xlsxWorksheet
  rawData         bufferedWriter
  mergeCellsCount int
  mergeCells      string
  tableParts      string
}
```

```go
func writeCell(buf *bufferedWriter, c xlsxC) {
    _, _ = buf.WriteString(`<c`)
    if c.XMLSpace.Value != "" {
        fmt.Fprintf(buf, ` xml:%s="%s"`,
                    c.XMLSpace.Name.Local, c.XMLSpace.Value)
    }
    fmt.Fprintf(buf, ` r="%s"`, c.R)
    if c.S != 0 {
        fmt.Fprintf(buf, ` s="%d"`, c.S)
    }
    if c.T != "" {
        fmt.Fprintf(buf, ` t="%s"`, c.T)
    }
    _, _ = buf.WriteString(`>`)
    if c.F != nil {
        _, _ = buf.WriteString(`<f>`)
        _ = xml.EscapeText(buf, []byte(c.F.Content))
        _, _ = buf.WriteString(`</f>`)
    }
    if c.V != "" {
        _, _ = buf.WriteString(`<v>`)
        _ = xml.EscapeText(buf, []byte(c.V))
        _, _ = buf.WriteString(`</v>`)
    }
    _, _ = buf.WriteString(`</c>`)
}
```

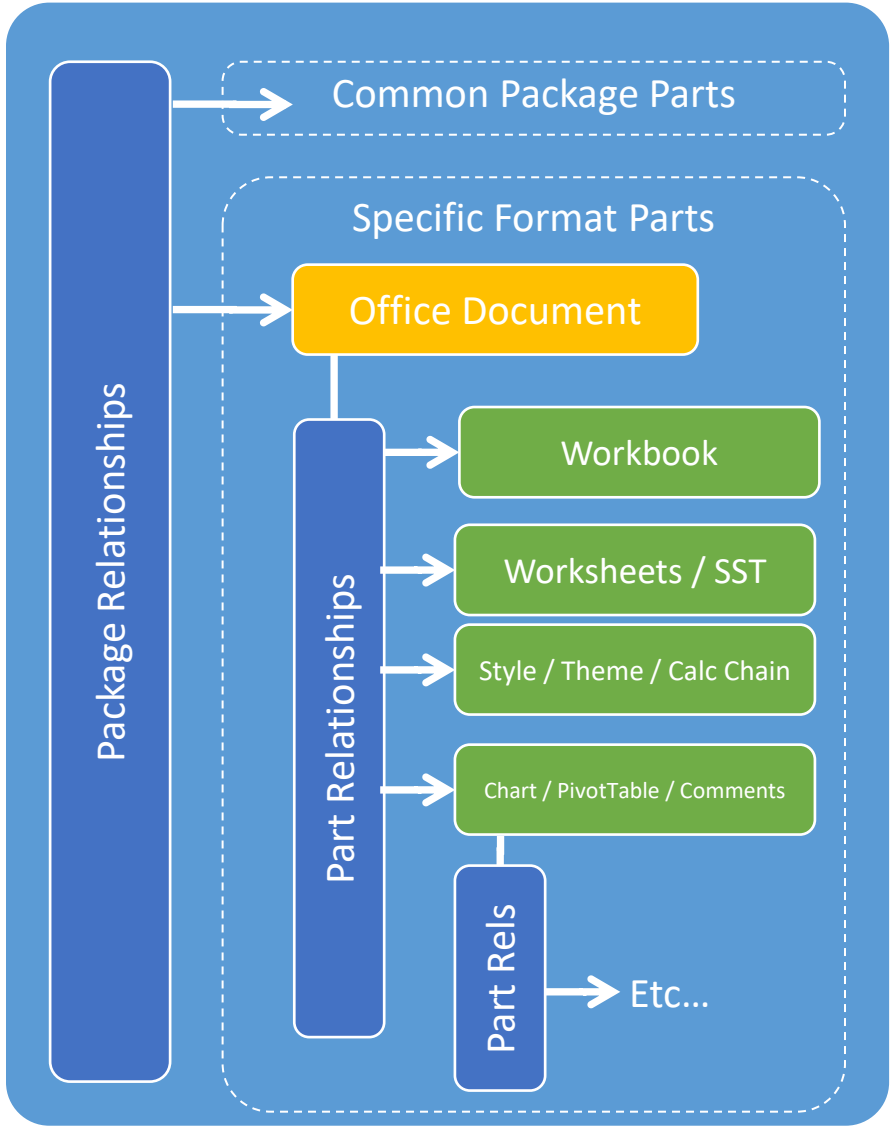
Flush

Generate XML Part

```go
type StreamWriter struct {
  File            *File
  Sheet           string
  SheetID         int
  worksheet       *xlsxWorksheet
  rawData         bufferedWriter
  mergeCellsCount int
  mergeCells      string
  tableParts      string
}
```

```go
func (sw *StreamWriter) Flush() error {
    _, _ = sw.rawData.WriteString(`</sheetData>`)
    bulkAppendFields(&sw.rawData, sw.worksheet, 8, 15)
    if sw.mergeCellsCount > 0 {
        sw.mergeCells = fmt.Sprintf(`<mergeCells
        count="%d">%s</mergeCells>`, sw.mergeCellsCount, sw.mergeCells)
    }
    _, _ = sw.rawData.WriteString(sw.mergeCells)
    bulkAppendFields(&sw.rawData, sw.worksheet, 17, 38)
    _, _ = sw.rawData.WriteString(sw.tableParts)
    bulkAppendFields(&sw.rawData, sw.worksheet, 40, 40)
    _, _ = sw.rawData.WriteString(`</worksheet>`)
        if err := sw.rawData.Flush(); err != nil {
        return err
    }
    // ...
}
```

Save Spreadsheet



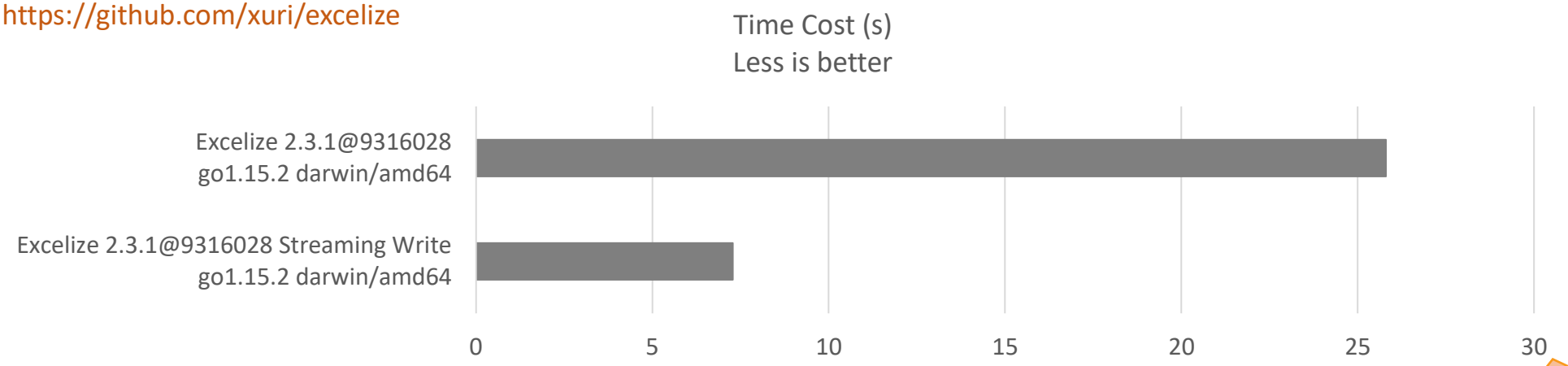
XML Part to ZIP

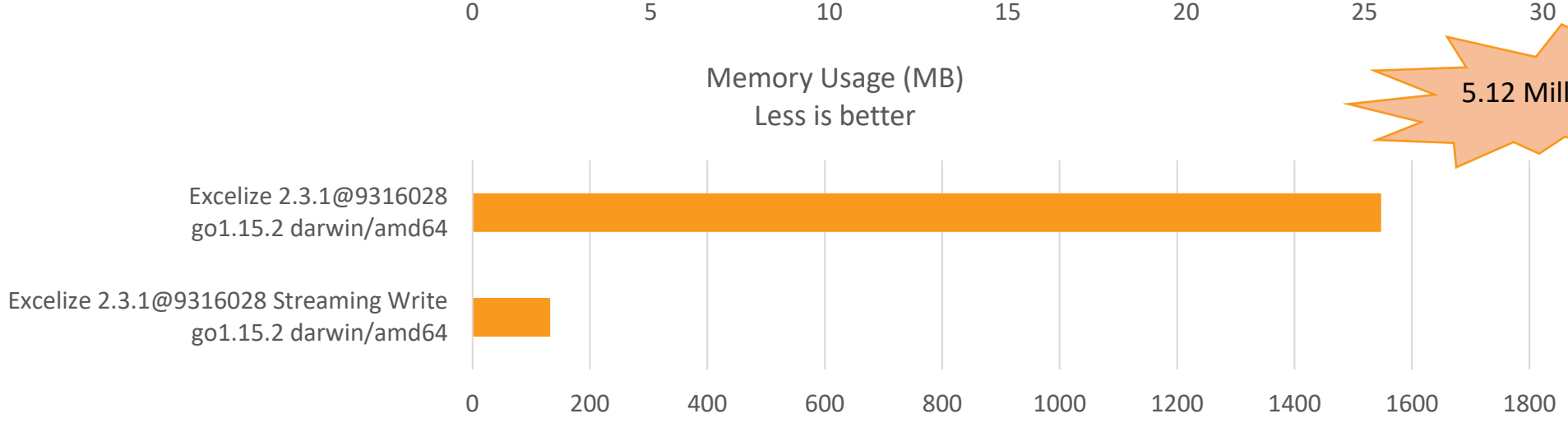
```go
func (f *File) WriteToBuffer() (*bytes.Buffer, error) {
	buf := new(bytes.Buffer)
	zw := zip.NewWriter(buf)
	f.calcChainWriter()
	f.commentsWriter()
	f.contentTypesWriter()
	f.drawingsWriter()
	f.vmlDrawingWriter()
	f.workBookWriter()
	f.workSheetWriter()
	f.relsWriter()
	f.sharedStringsWriter()
	f.styleSheetWriter()

	for path, stream := range f.streams {
		// Save stream data
		stream.rawData.Close()
	}

	for path, content := range f.XLSX {
		// Save preserve data
	}
}
```

Performance

102400 Row x 50 Columns, 6 Chars / Cell

https://github.com/xuri/excelize





5.12 Million Cells

Processing XML and Spreadsheet in Go

Gopher China Conference
Beijing 2021 6/26 - 6/27

续日