NIEM Overview

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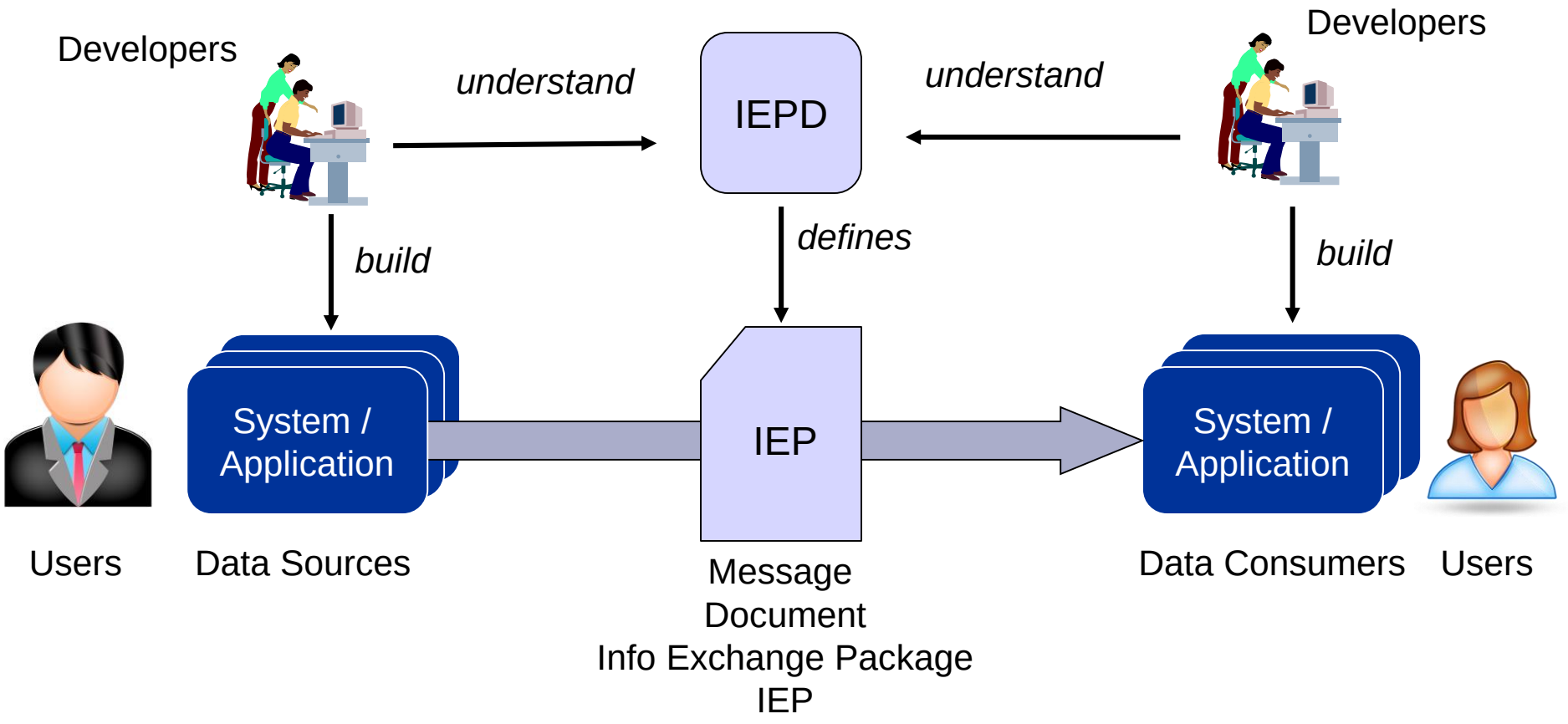
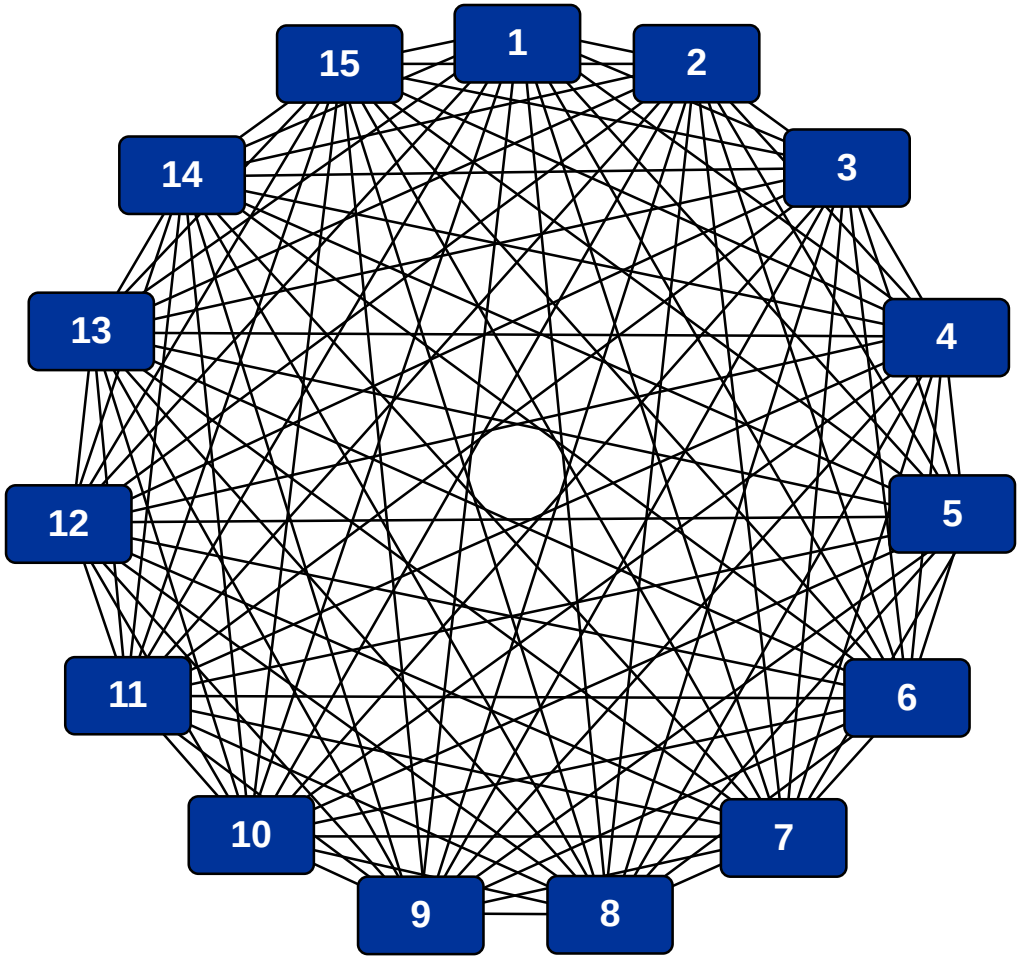
Data Interoperability

Message Format
Document Schema
Information Exchange Package Documentation
IEPD



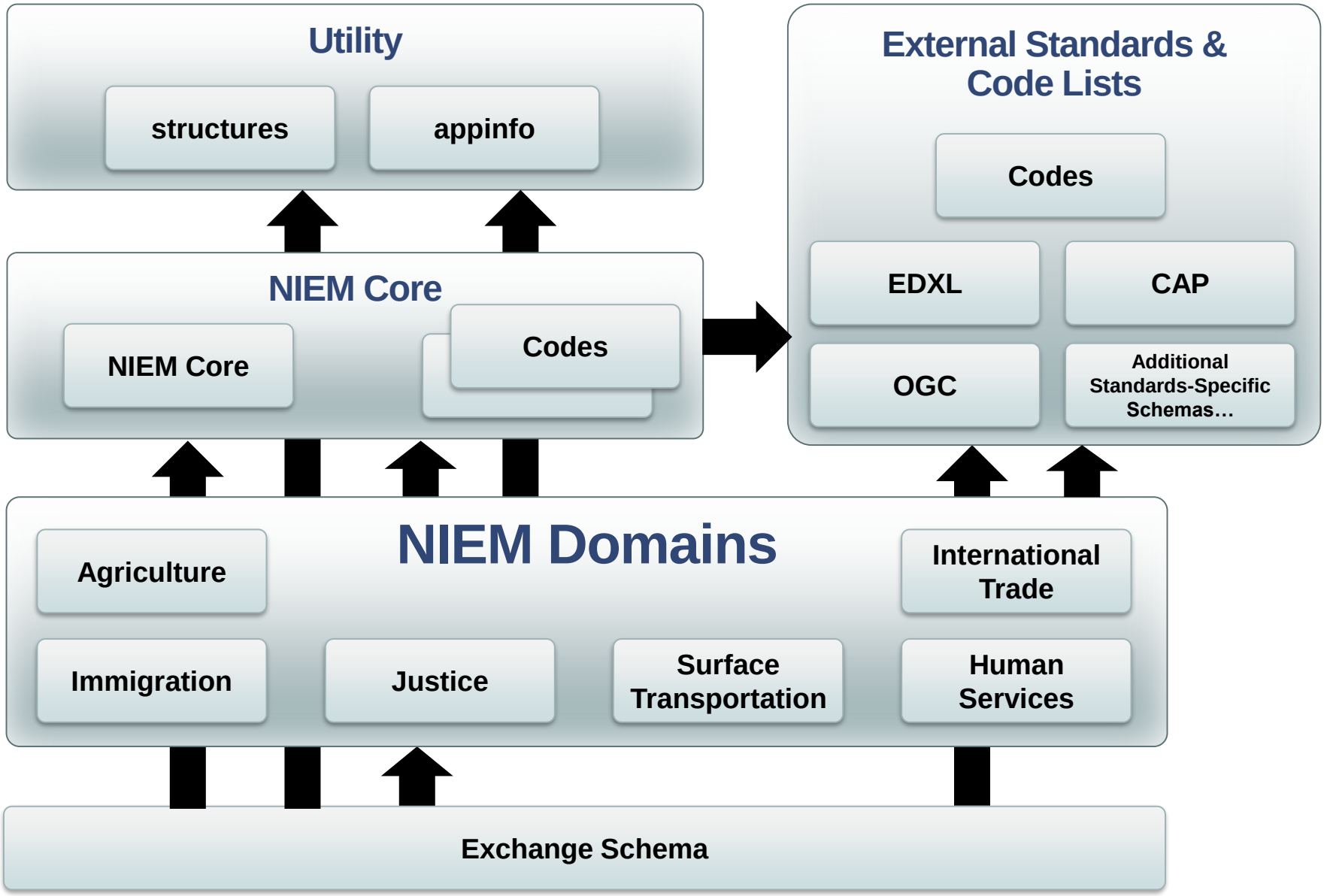
Pairwise Agreements Don't Scale



The N^2 problem
15 applications
105 negotiations
Total level of effort is $O(n^2)$

NIEM

Organize Agreement by Community



NIEM

Common NIEM Namespace Prefixes

Namespaces prevent *collisions* of names of types and elements, because names can only be used when referenced through a namespace.

Each namespace is a URI (e.g., http://release.niem.gov/niem/niem-core/4.0/)

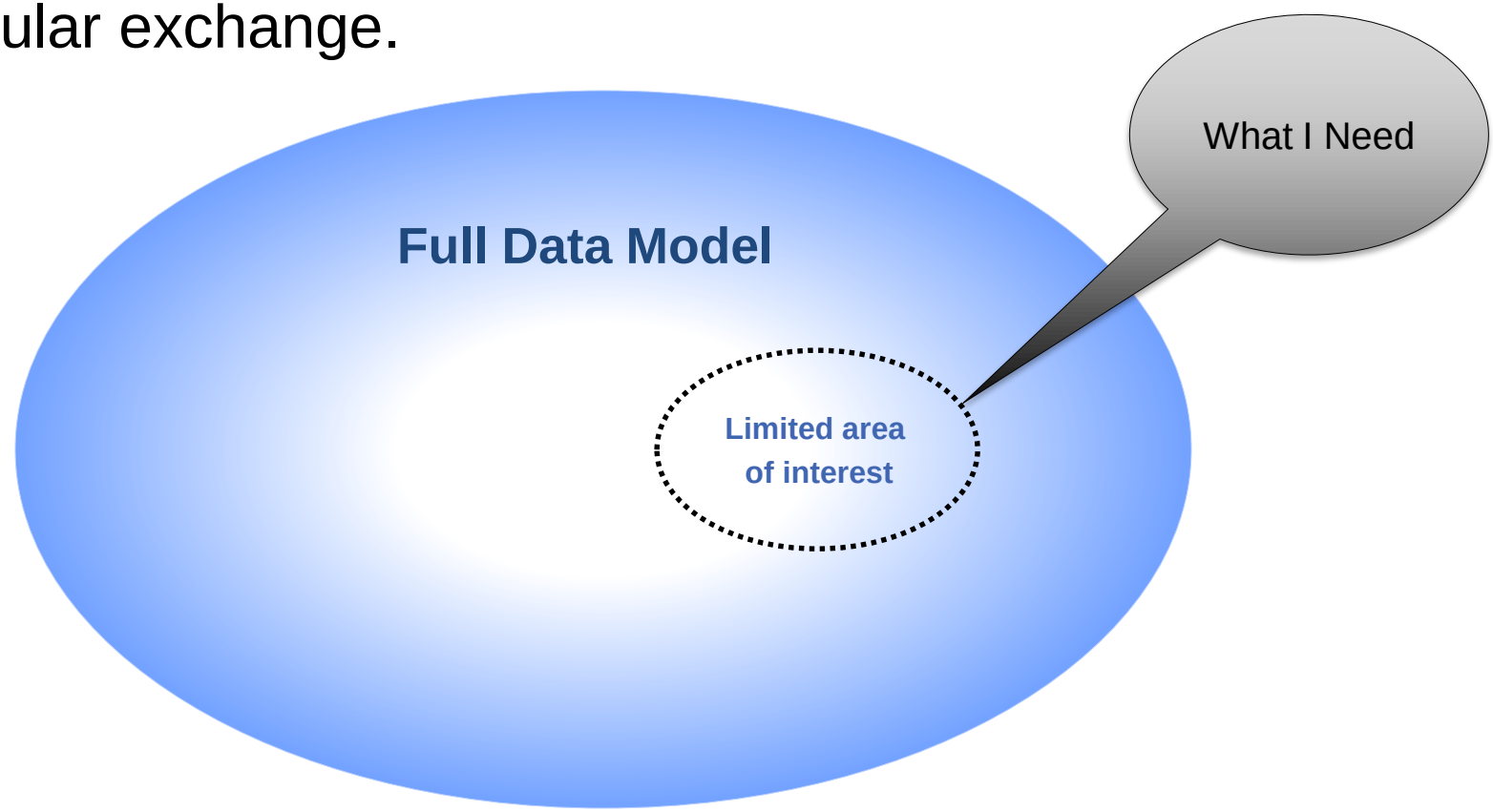
For consistency, each NIEM release uses prefixes consistently:

Prefix	Namespace Name
structures	structures
appinfo	Appinfo
nc	NIEM Core
niem-xsd	Proxy
j	Justice
im	Immigration
cyfs	Child, Youth and Family Services

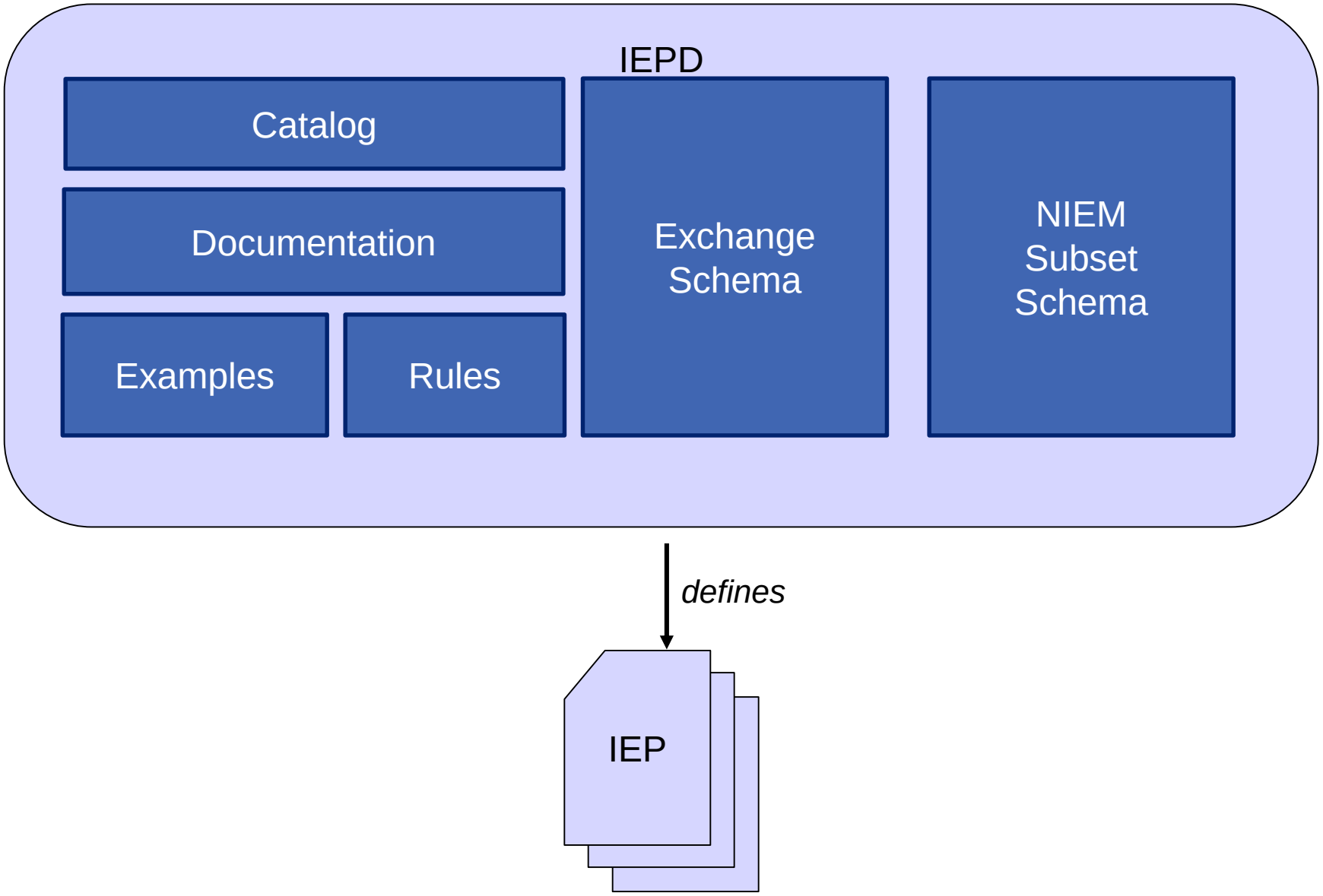
Prefix	Namespace Name
m	Maritime
it	International Trade
em	Emergency Management
ip	Infrastructure Protection
cbrn	Chem/Bio/Rad/Nuc
scr	Screening

Subset Schema

A Subset schema contains only those types, elements, and enumerations needed for a particular exchange.

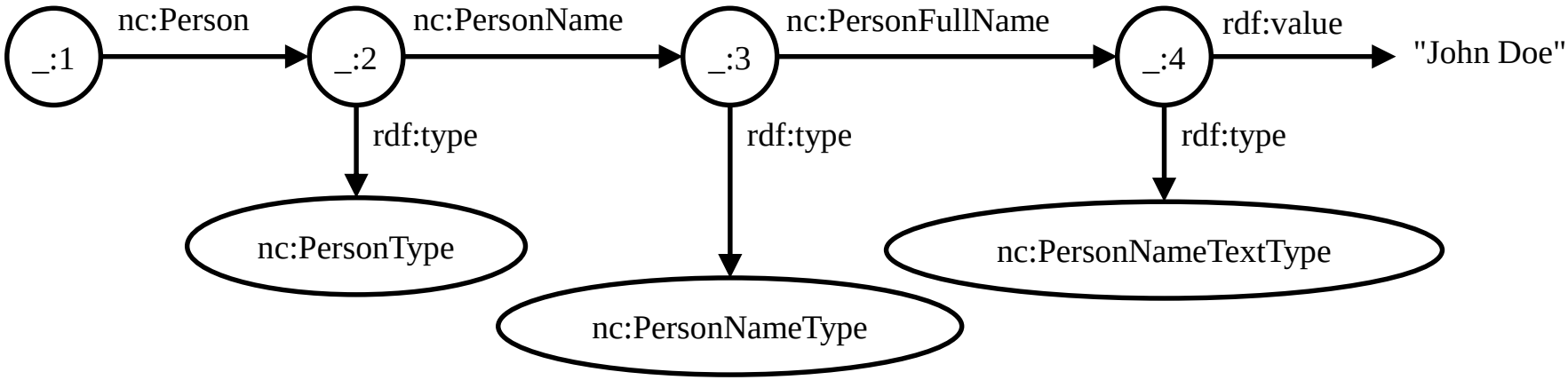


An Exchange is a Contract



Meaning of XML Data

```
<nc:Person>
  <nc:PersonName>
    <nc:PersonFullName>John Doe</nc:PersonFullName>
  </nc:PersonName>
</nc:Person>
```



The **message** plus the **schema** plus the **NIEM rules** entails the **meaning**.

The RDF conceptual model describes graphs of data, which describe the meaning of data. NIEM rules define schema concepts in terms of RDF concepts.

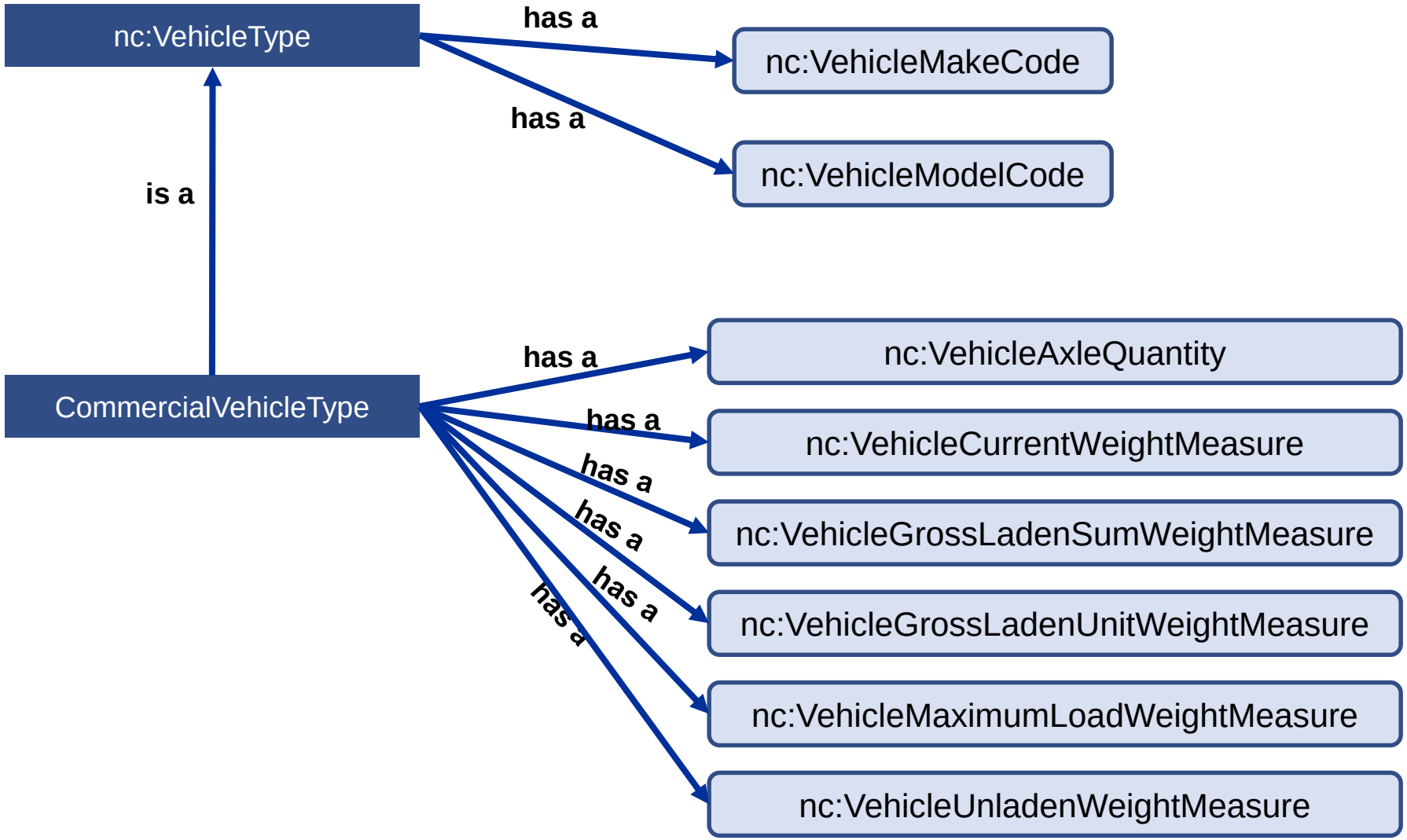
RDF concepts: class, property ("has-a"), subclass ("is-a"), subproperty, type

Meaning of XML Data

```
<nc:Person>
  <nc:PersonName>
    <nc:PersonFullName>John Doe</nc:PersonFullName>
  </nc:PersonName>
</nc:Person>
```

XML description	The Meaning of the data
The top element occurs within some context, about which the above data tells us nothing.	There is some object, representing whatever is outside the outer element.
The top element is nc:Person. The NIEM reference schema defines the type of the element as nc:PersonType.	There is a relationship, called nc:Person, between the unknown context object and an object of type nc:PersonType.
The next element is nc:PersonName. The schema indicates that element is of type nc:PersonNameType.	There is a relationship called nc:PersonName between the object of type nc:PersonType and an object of type nc:PersonNameType.
The next element is nc:PersonFullName. The schema shows that the element is of type nc:PersonNameTextType.	There is a relationship, called nc:PersonFullName, from the object of type nc:PersonNameType to an object of type nc:PersonNameTextType.
Within that element is the simple value John Doe. The schema tells us the content of that element is of simple type xs:string.	The object of type nc:PersonNameTextType has a value that is the literal John Doe.

Inheritance of Types



Inheritance in XML Schema

```
<xsd:complexType name="CommercialVehicleType">
  <xsd:complexContent>
    <xsd:extension base="nc:VehicleType">
      <xsd:sequence>
      <!-- inherits all desired properties from nc:VehicleType
      e.g. nc:VehicleMakeCode, nc:VehicleModelCode, nc:VehicleVINAText -->
        <xsd:element ref="nc:VehicleAxleQuantity"/>
        <xsd:element ref="nc:VehicleCurrentWeightMeasure"/>
        <xsd:element ref="nc:VehicleGrossLadenSumWeightMeasure"/>
        <xsd:element ref="nc:VehicleGrossLadenUnitWeightMeasure"/>
        <xsd:element ref="nc:VehicleMaximumLoadWeightMeasure"/>
        <xsd:element ref="nc:VehicleUnladenWeightMeasure"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
```

Inherits all properties of nc:VehicleType

NIEM Data Modeling Features

NIEM provides additional features, supporting data modeling needs:

- Role: Identify a function or responsibility of something
  - *A weapon is a role of an item*
- Association: Represent complex relationships, with characteristics
  - *Employment is an association between an employee and an employer*
- Code list: Represent lists of concepts, with text representations and characteristics
  - *The GENC geo-division code list identifies states, counties, parishes, etc.*
- Augmentation: Easily add new characteristics to something
  - *The Justice domain provides an indicator of whether a NIEM-core person is a parolee, as an augmentation of a NIEM-core person type.*
- Metadata: Provide data about other data
  - *The Justice domain provides an indicator of whether any piece of information is criminal information, as metadata.*
- Representation: Provide alternatives to how something is represented
  - *A date may be represented as a bare date, a date with a time, a day and a month, a month, a year, a quarter, etc.*

NIEM Conformance

NIEM defines *conformance targets*, for special kinds of things:

- Reference schema document
- Extension schema document
- Conformant schema document set
- Conformant instance
- IEPD

Rules for conformant artifacts ensure:

- Portability: artifacts work across systems, tools, and platforms
- Comprehensibility: messages and schemas can be understood; messages can be verified against schemas, we know what the parts of an IEPD are
- Consistency: users and developers aren't surprised or confused when they see how messages and schemas are built; terms and components mean the same thing everywhere they are used
- Extensibility: components can be reused to accommodate requirements of exchanges
- Affordability: minimize custom definitions; reuse everything you can; implement with free tools
- Agility: loose coupling ensures ability to change systems without impacting exchanges; explicit versioning ensures ability to upgrade deliberately without breaking existing interfaces

Benefit: Global ID For Every Data Component

```
<hs:PersonOtherKinAssociation
  xmlns:cyfs="http://release.niem.gov/niem/domains/hs/4.1/"
  xmlns:j="http://release.niem.gov/niem/domains/jxdm/6.1/"m
  xmlns:nc="http://release.niem.gov/niem/niem-core/4.0/">
  <hs:SourcePerson>
    <nc:PersonAgeMeasure>
      <nc:MeasureIntegerValue>14</nc:MeasureIntegerValue>
      <nc:TimeUnitCode>ANN</nc:TimeUnitCode>
    </nc:PersonAgeMeasure>
    <j:PersonHairColorCode>BRO</j:PersonHairColorCode>
    <nc:PersonName>
      <nc:PersonGivenName>Rick</nc:PersonGivenName>
      <nc:PersonSu
    </nc:PersonNam
  </hs:SourcePerso
  ...
</hs:PersonOtherKi
```

Namespace declaration
+
Qualified name
=
URI: http://release.niem.gov/niem/niem-core/4.0/#PersonName

Benefit: Self-Describing Data

```
<xs:element name="PersonName" type="nc:PersonNameType"
  <xs:annotation>
    <xs:documentation>A combination of names and/or titles
by which a person is known.</xs:documentation>
  </xs:annotation>
</xs:element>
```

NIEM Reference Schema
http://release.niem.gov/niem/niem-core/4.0/

Schema Element URI

http://release.niem.gov/niem/niem-core/4.0/#PersonName

```
xmlns:j="http://release.niem.gov/niem/domains/jxdm/6.1/"
xmlns:nc="http://release.niem.gov/niem/niem-core/4.0/">
<hs:SourcePerson>
  <nc:PersonAgeMeasure>
    <nc:MeasureIntegerValue>14</nc:MeasureIntegerValue>
    <nc:TimeUnitCode>ANN</nc:TimeUnitCode>
  </nc:PersonAgeMeasure>
  <j:PersonHairColorCode>BRO</j:PersonHairColorCode>
  <nc:PersonName>
    <nc:PersonGivenName>Rick</nc:PersonGivenName>
```

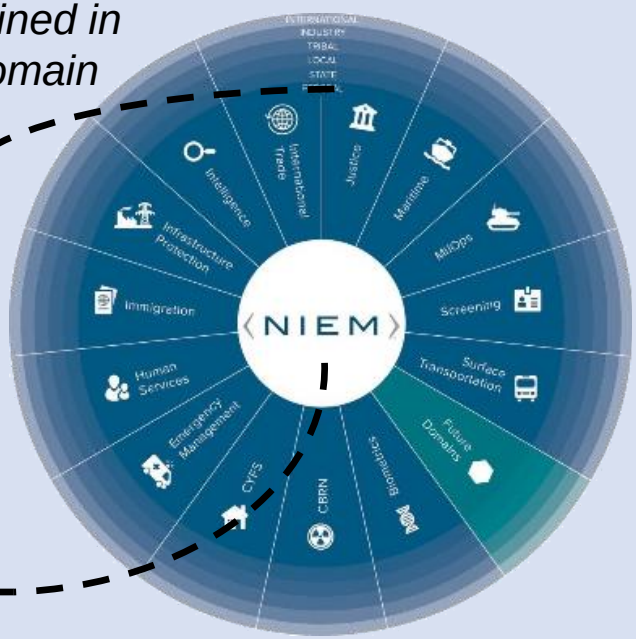
XML data exchanged at runtime

Benefit: Enterprise Reuse of Data Definitions

```
<hs:PersonOtherKinAssociation
  xmlns:hs="http://release.n
  xmlns:j="http://release.ni
  xmlns:nc="http://release.
  <hs:SourcePerson>
    <nc:PersonAgeMeasure>
      <nc:MeasureIntegerVal
      <nc:TimeUnitCode>ANN<
    </nc:PersonAgeMeasure>
    <j:PersonHairColorCode>
    <nc:PersonName>
      <nc:PersonGivenName>R
      <nc:PersonSurName>Wil
    </nc:PersonName>
  </hs:SourcePerson>
  ...
</hs:PersonOtherKinAssociati
```

defined in domain

defined in core



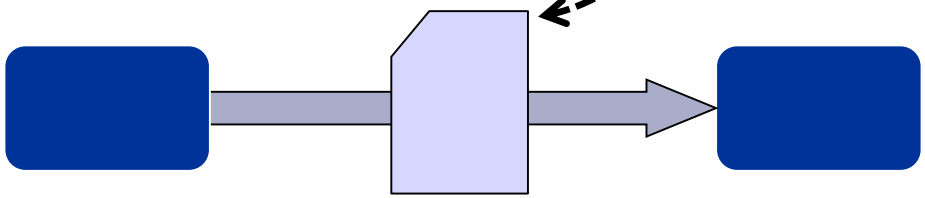
Working with NIEM, developers create shared data definitions where useful, reuse shared definitions when appropriate

Benefit: Schemas Constrain Runtime Data

Subset schema in the IEPD

```
<xs:complexType name="PersonType">
  <xs:annotation>
    <xs:documentation>A data type for a human being.</xs:docu
  </xs:annotation>
  <xs:complexContent>
    <xs:extension base="structures:ObjectType">
      <xs:sequence>
        <xs:element ref="nc:PersonAgeMeasure" minOccurs="0"/>
        <xs:element ref="nc:PersonHairColor" minOccurs="0"/>
        <xs:element ref="nc:PersonName" minOccurs="1"/>
      </xs:sequence>
```

PersonAgeMeasure is optional
PersonHairColor is optional
PersonName is required
Nothing else is allowed



NIEM: Not Just For XML Any More

NIEM-conforming data can be

```
<j:PersonHairColorCode>BRO</j:PersonH
<nc:PersonName>
  <nc:PersonGivenName>Rick</n
<nc:PersonSurName>Wilson</nc:PersonSu
</nc:PersonName>
```

XML ✓

```
"j:PersonHairColorCode": "BRO",
"nc:PersonName": {
  "nc:PersonGivenName": "Rick
  "nc:PersonSurName": "Wilson"
}
```

JSON ✓

```
_:n2 j:PersonHairColorCode "BRO" ;
     nc:PersonName        _:n4
_:n4 nc:PersonGivenName "Rick
     nc:PersonSurName    "Wilson" .
```

RDF ✓

NIEM data definitions can be

```
<xs:complexType name="PersonType">
 <xs:complexContent>
  <xs:extension base="str
    <xs:sequence>
      <xs:element ref="nc:PersonAccen
```

XML Schema ✓

TBD

JSON Schema

```
nc:PersonType
  a owl:Class ;
  rdfs:comment "A data type
  rdfs:subClassOf [
    a owl:Restriction ;
```

OWL

✓ Working Now

In development

Specifications and Tools

The NIEM 4.0 release: https://niem.github.io/niem-releases/

NIEM training: https://niem.github.io/training

NIEM documentation: https://niem.github.io/reference

Tools

- The Schema Subset Generation Tool: Browse & Search the NIEM data model, while building a NIEM Schema Subset to use in an IEPD
  - https://tools.niem.gov/niemtools/ssgt/index.iepd
- The NIEM Movement Tool: Quickly search the NIEM data model
  - https://beta.movement.niem.gov/
- The NIEM Conformance Testing Assistant: Check NIEM IEPDs and schemas against the NIEM rules
  - https://tools.niem.gov/contesa/

Specifications

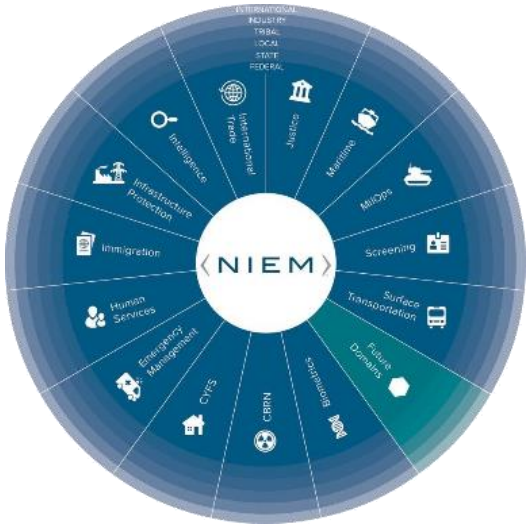
- The NIEM Naming and Design Rules: Defines modeling features of NIEM, the profile of XML Schema used by NIEM Schemas, and the meaning of messages.
- The Model Package Descriptions Specification: Defines how to package schemas, rules, and documentation into an IEPD to define an exchange.
- The NIEM Code Lists Specification: Defines how to represent code lists as spreadsheet CSV files or Genericode XML files, and use them to define and interpret messages.

NIEM Is . . .

A Community

- Federal, State, Local, International, Non-Govt.
- Self-Managing Domain Stewards
- Voluntary Consensus Standards
- Help Desk & Knowledge Center
- Established Training Program
- Technical Specifications

A Data Model



organized as a core plus subject-area domains, expressed as reusable XML Schema components

A Reusable Process

and a template for designing information exchange specifications by reusing XML Schema components